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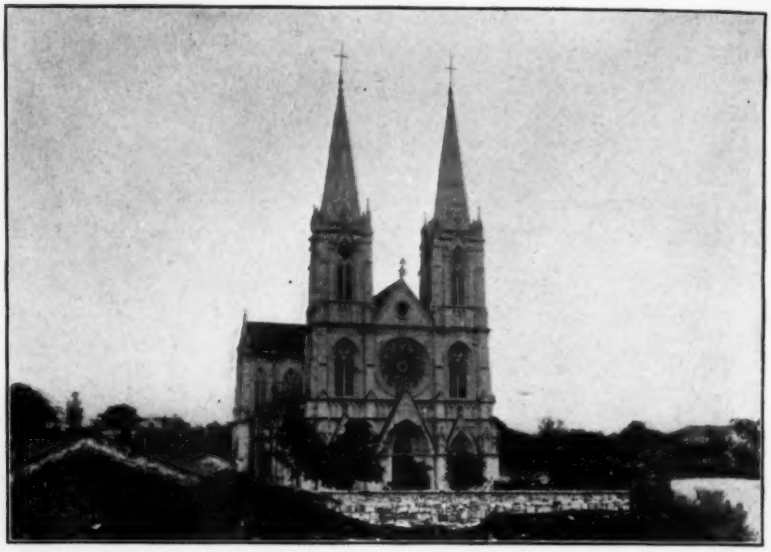
CHINA'S RENAISSANCE.

By CHARLES KEYSER EDMUNDS, Ph.D.,
CANTON CHRISTIAN COLLEGE.

So long as constant forces and invariable conditions characterize a phenomenon, it is more or less easy to determine its course. But no matter how regular any known part of the representative curve of coordinates may be, extrapolation is always precarious and fraught with uncertainties. The careful observer is ever on the watch for so-called 'critical points,' times or places when or where entirely new and extraneous forces or hitherto latent internal potentialities begin to operate, and for a time at least, if not henceforth, to dominate the course of events. It is generally true that a comprehensive knowledge of such critical points is far more illuminating as to the real nature of the phenomenon in question than that of any other part of the curve, though of course it is essential to be familiar with the 'normal trend' as well. Many examples could be cited in the realm of physical science, but the one to which this series of papers attempts to call attention is of far more lively interest and pregnant with the destinies of the whole human race.

That China is facing a crisis amid the tramping of armies on her north and amid the increasing murmur of a discontented people within her own borders is clear to all close observers of the empire. The oldest, largest and most conservative nation of the world, with its home in the orient, is awakening under the impact of western ideas in trade, religion and education. Albeit that from the start there could be but one final issue, the progress of events well repays careful study.

This impact began along entirely commercial lines, then religious and hence educational, and finally because of the growth and future



A CONTRAST: TWO CONSPICUOUS LANDMARKS OF CANTON.

THE FRENCH CATHDERAL, CANTON. Built in 1860 on the site of the native Governor-General's residence, which was destroyed and the ground seized at the close of the Franco-Chinese war, 1856. The steel frame and the windows were brought from Paris.

THE FIVE-STORY PAGODA ON THE WALL OF CANTON. Built some five hundred years ago as a huge watchtower to aid in keeping back the Tartars. Constructed of sawn blocks of red sandstone and hardwood columns and timbers—well preserved to-day. Foreign troops were garrisoned here at the time of China's war with England and France.

possibilities of the first, it has become of wide political import. After noting briefly in this paper the period of beginnings and indicating the present-day aspects of this threefold renaissance, we shall in subsequent papers confine ourselves to a consideration of the educational factors.

The intercourse between China and the West began when the Portuguese sent their first trading vessel to her southern ports, of which Canton is the chief, in 1516, and till 1842 it was a purely commercial relation in which the power and civilization of Europe were represented for the most part by the East India Company, seeking only for the

A TYPICAL STREET SCENE IN VICTORIA, HONGKONG.

advantages of trade and persistently opposing all efforts designed to enlighten the people with whom they dealt. "The attitude of official China during this period was that of supercilious arrogance. China sought no intercourse with outsiders. If they sought trade with her, it was granted as a gracious favor by an officialdom which despised trade and traders too much to attend seriously to the details involved until they became matters threatening international rupture."

The event which began the new order of things was the 'opium war' between Great Britain and China, which, though little to the credit of a righteous nation, nevertheless has served as the origin of what must ultimately be of immeasurable benefit to the more benighted land. By the treaty of peace of 1842 British subjects were permitted to reside at certain important ports along the eastern coast and to trade

with whom they pleased. This was soon extended to subjects of the United States and France, and since then the rights of foreigners in China have steadily increased. There are now over thirty 'treaty ports,' the gateways of Western trade and influence.

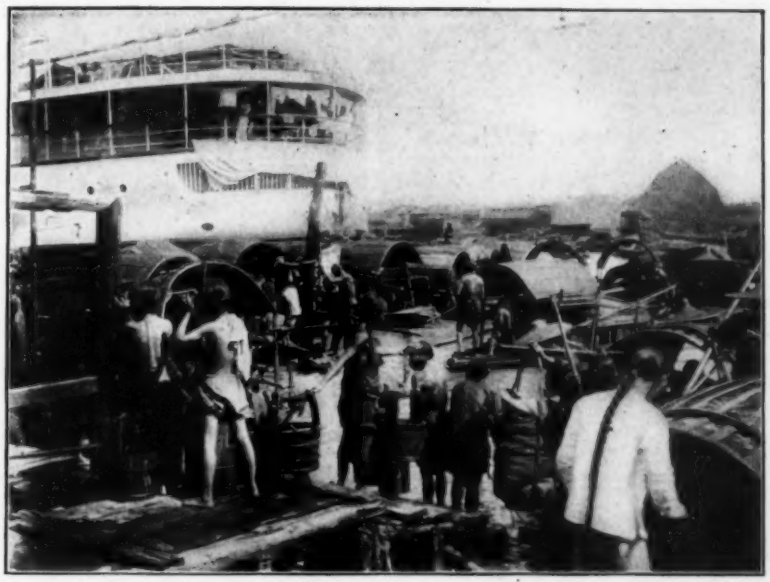
American commerce with China began in 1784, the first ship leaving New York on Washington's birthday of that year, and taking fifteen months for the round trip. Our trade with China has been successful from the start, and is greater in importance and value than that of any other nation except Great Britain. With all the rapid developments of modern commerce and the pressure which every commercial nation is exerting in that quarter, our sales to China have quadrupled in the last decade. This rapid growth, together with other recent events in the far east, has warranted the U. S. Department of Commerce and Labor in publishing a quarto volume of some hundred and twenty pages on 'Commercial China in 1904.' Some of the introductory sentences of this monograph are significant in the present connection:

> With an area of 4,000,000 square miles and a population of 400,000,000 people, its written history, covering thousands of years, shows that its doors have been firmly closed against foreign trade until within the memory of the present generation, while during the short time in which foreigners have been admitted to its commerce no period has been so marked with important commercial developments as that of the past three years. With hundreds of miles of railway now in operation and thousands of miles projected; with telegraphs connecting its capital with every province and even its far away dependencies and also with the outside world; with steam navigation and foreign vessels penetrating to the very head of its many navigable waterways; with new treaty ports opening upon the coast and far inland, and with foreigners permitted to travel for business or pleasure to the remotest corners of the Empire and carry with them their merchandise and the machinery with which it is manufactured, the changes in conditions are such as to attract unusual attention.

The expansion of the great powers of the world has culminated in the armed strife on China's northern border which is holding the attention of the civilized world. The issue in the east may be briefly stated, but it concerns hundreds of millions of the human race. 'Shall Japan, Siam, Korea and China be free to work out their own national destinies?'* Japan and Siam have already made great strides, but while they may seem to be beyond outside domination, their fate is still involved in no small measure with that of China. The issue in the orient is sharply drawn: 'independent national development for China, and continued progress of the other two free Asiatic states; or the subjection of China, and the endangering of all free nationality in Asia.'

The loss of free nationality in Asia would probably be a calamity to mankind. However justly the occidental may pride himself on his mastery of the art of living, however truly he may rejoice in his achievement throughout the whole reach of life, a sane modesty, taught him by his own science, should keep him from regarding western peoples as the

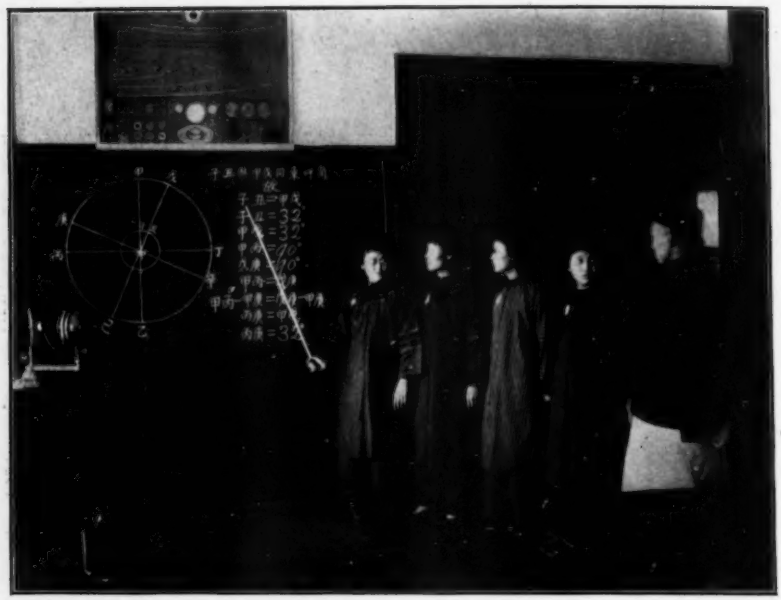
* See 'To Save the Chinese Empire,' by O. D. Wannamaker, *The South China Collegian*, Canton, China, July, 1904.

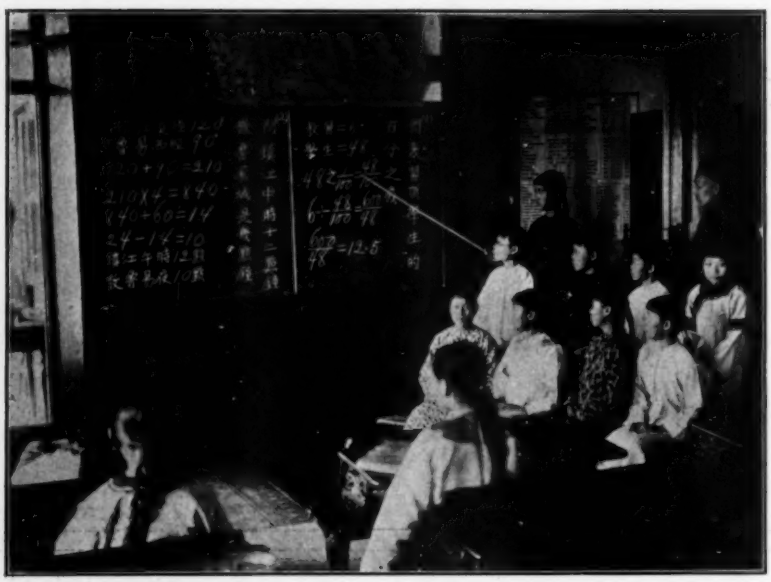


MODERN HARBOR OF CANTON, where foreign commerce with China first began.

(*a*) Looking from Honam across the Canton River towards the city. Customs station prominent near center of river front as shown. The tall buildings are pawnshops. White Cloud Mountain appears to the north.

(*b*) In the rear of a departing river steamer bound for Hong Kong ninety miles away. Native sampans ('three-board') and ma lung tenas ('slipper'-boats) in great profusion and confusion. Note the water-carriers drawing the city's main water-supply. The only pure water obtainable, except rain water, is that brought in buckets from near the top of White Cloud Mountain. Deep artesian wells have not as yet been sunk. This in a city of two million people!





CLASS-ROOM WORK AT GIRLS' ACADEMY, METHODIST MISSION, CHINKIANG.

A significant indicator of China's true and inevitable renaissance, showing the advanced training afforded the long-neglected daughters of the race and eagerly sought by them.

whole race of man, or from looking with scorn upon entire divisions of the race whom his training has not fitted him to appreciate. "A proper reverence for humanity will not allow him to exalt his own position at the expense of the entire east, or to attempt crudely to force upon a whole continent external domination or those forms of civilization which are the product in some part of himself." From the higher level of human development, expansion and domination we may well feel that the world is destined to profit greatly by present events in the far east if they result in restoring to humanity the whole continent of Asia, free to join in making the history of the next hundred years, free to be itself and to supplement, with all of good there is manifest or dormant in it, the strength and goodness of the west.

The shortest road to a partial success in this endeavor to preserve free nationality in Asia is the development of China's material resources, which will not only enrich China and the world, but will help to arouse the people from their age-long sleep; and it may be that military development consequent upon this awakening will serve to maintain the empire's independence.

But China's independence should concern her friends in the west chiefly because such independence is essential to something far more important: true freedom for the Chinese people. "The dormant powers now awaking in this race and promising such a future for it in the commercial and political affairs of the world demand imperatively that there be set in motion, side by side with this material transformation, forces far more subtle that shall bring about a true renaissance of the nation by influencing profoundly the intellect and the soul of the race. Only so can the Chinese people be speedily restored to the modern world."

Without books, newspapers, the pulpit, political debate, general assemblies, etc., China's people have long been groping in the dark. An ignorant people can not be patriotic, nor can there be any steady progress in commerce, agriculture or manufactures among them. These are not due to any extent to differences in government. Democracy among an ignorant people is impossible, or at least dangerous. Although China's scholars of the old school have a superior education in some respects, it is after all too narrow to fit them for lives of service to their fellows. The literati oppose changes because they are ignorant and fear to tread a new path in the dark.

But the ignorance of the people in general or of the literati is not the most dangerous part of China's ignorance; it is the blatant and conceited ignorance of those young men who know little of the foundations of China's civilization and less of western institutions, who wish to tear down the old without knowing how to build up the new. Ignorant of what it means to govern so great a nation as China and to

CHINESE GIRLS IN THE SCHOOL AT CHIN KIANG.

adjust her relations with the world, they wish to plunge at once into anarchy. They are too willing to move because they do not know China, while the literati are unwilling to move because they do not know the world. China needs men who know the institutions of both China and the west, who see clearly the foundations of all real civilizations, and hence can help their nation forward.

From the very beginning of foreign intercourse with China, men have not been wanting whose vision was clear and disinterested enough to lead them to devote untiring energy to dispel the darkness of China's ignorance and superstition. With the opening of the nineteenth century the missionary societies began trying to find an entrance for christianity and modern civilization into the Celestial Empire, but they were obliged, on account of the repellent forces still operative, to content themselves with such work as could be carried on among the emigrant Chinese in the vicinity of the Malay Peninsula, so that during the first period of large commercial intercourse with China (1677–1841), there was no modern educational effort within the confines of the empire. Through the work of the Society for the Diffusion of Useful Knowledge in China, founded in 1834, a beginning of western education within the borders of China was made by the printed page, while as yet the founding of schools within the country was impracticable.

Parallel with official China's arrogance with regard to trade was literary China's proud confidence in the axiom, "What Confucius teaches is true; what is contrary to his teaching is false; what he does not teach is unnecessary." "Confucius lived 2,400 years ago. Theirs was an assurance rooted in undisputed tradition, and fortified by the accumulated conservatism of two and a half millenniums of undisturbed conformity."* The problem was how to teach a nation that had no desire to learn; no desire, not from lack of interest in learning so much as because they believed themselves to have a monopoly of valuable knowledge.

Effective contact of western thought with this colossus of conceited ignorance began on the cession of Hongkong to the British in 1842, when the British government assumed responsibility for the education of the Chinese population of the island. Though numbering only 5,000 at the start, it has since multiplied to 270,000, and considerably more than half a million Chinese pass annually between Hongkong and various parts of the mainland, so that the importance of Hongkong as a distributing center of ideas as well as of material products must not be underestimated, though a frank observer is somewhat disappointed at the inadequate way in which the opportunities for higher education are being improved.

* See 'Western Education in South China,' O. F. Wisner. 'East of Asia,' Special Educational Number, Shanghai, June, 1904.

CHINESE GIRLS IN THE SCHOOL OF CHIN KIANG.

Encouraged by the more liberal atmosphere created by the colonial government and by the contiguity to the great empire to be influenced, the Morrison school, started four years before in Macao, was removed to Hongkong in 1843, followed in 1844 by the Anglo-Chinese College of Mallaca (founded also by Morrison in 1818). Many educational enterprises have since developed in Hongkong, though the results do not measure up to those in most of the schools in central and north China.

Educational work within the actual borders of China began when the treaty ports provided for in 1842 were opened up. Canton was the chief of these, and there as early as 1835 Dr. Peter Parker had opened the Canton Hospital, and this together with other benevolent medical work helped to pave the way for more extensive evangelistic and educational activities by creating a more friendly feeling towards foreigners among the Chinese. Though having its beginnings in the south, this educational work rapidly spread, and there is now scarcely a mission from Canton to Peking without its primary school, day school, intermediate school, night school or college. There are about 2,000 day schools with 35,400 pupils, and 170 higher schools with some 5,000 or more students. A few of these are girls' academies, in which there are courses of study equal to those of schools of a like grade in the United States, and pursued with equal credit. The oldest of these boarding schools for girls is that begun by the Wesleyan mission at Canton in 1861. Among the leading christian colleges, the one which has had the most graduates and the widest influence is the Shangtung College, founded at Tengchou (now at Weihsien) by the Presbyterians in 1864, under Dr. Calvin W. Mateer.

The work of this body of christian educators, small as it has been, has had an immeasurable effect. Awakened under the influence of this silent agency, and more rudely by the results of the China-Japan war and the events of 1899–1900, China's leaders have been made to see that the trouble lies in their faulty system and ideals of education; and have in nearly every case of educational reform called to their aid men hitherto prominent in educational missions. One of the most remarkable indications of the change that is coming over China is the spectacle of such eminent officials and scholars as Chang Chih Tung and Yuan Shih Kai urging upon the younger scholars the necessity of studying western sciences and becoming acquainted with the accomplishments of other nations. The government has begun to adopt measures to facilitate this course. In 1901, while the court was still in exile, a series of edicts was issued commanding a reorganization of the educational system of the empire, calling for changes in the examination system hitherto in vogue, for the establishment of an Imperial University at Peking and a large number of other high-grade institutions in all parts

of the empire. Although the active response of the provincial officials has been somewhat tardy and inadequate in many instances, there are abundant signs that, without doubt, the renovation of the worn-out system of education is at hand. Just what the efforts of the government have been and the results they are producing will be noticed in more detail in a later paper; suffice it now to point out that whereas at first it was a problem of how to educate a people who did not desire enlightenment because they fondly thought they already possessed all useful knowledge, the present problem is how to pass from old ways to radically new ones with the least friction among a people still in great part thoroughly conservative, but embracing numerous individuals thirsting for the newer learning. For realizing that the complete refutation of the age-long methods of the past is China herself, the most progressive officials and many of the young men are becoming sensible not only of the precarious position of their nation, but of their individual poverty and need of education.

During 1903 the new publications of the Society for the Diffusion of Christian and General Knowledge among the Chinese amounted to 11,434,600 pages, while *The Review of the Times,* a Chinese monthly, edited by Dr. Young J. Allen, published 54,400 copies. The corresponding figures for 1904 are 19,256,800 pages of new publications, 45,500 copies of *The Review of the Times* and 80,000 copies of *The Chinese Weekly,* edited by W. A. Cornaby. The total of reprints and new publications has grown from 25,353,880 pages in 1903 to 30,681,800 pages in 1904. Moreover, a conservative estimate puts the piracy of all the best books of this society by various native presses at five times the direct output of the society! During 1903 the Diffusion Society sold 35 complete sets and four supplements of the 'Encyclopædia Britannica' in English, while hundreds applied for it in Chinese. Several legitimate native publishing houses have recently sprung up, the chief of which, the Commercial Press of Shanghai, is literally sending forth volume after volume of new literature, mostly translations of works that have proved their usefulness among other nations. That the high officials are being influenced by the translations of the Diffusion Society is clear from the remarkable changes in the questions set throughout the empire for the literary examinations for the second degree, samples of which will be fully treated in a later article.

THE SCIENCE OF PLANT PATHOLOGY.

By Professor FRANK LINCOLN STEVENS, Ph.D.,
NORTH CAROLINA COLLEGE OF AGRICULTURE.

FROM the time men first had interest in plants, knowledge of their imperfections or premature death has existed, without, however, definite conception that the imperfections in question really constitute a condition of disease.

The Bible and the early writings of the Greeks and Romans contain references to what we now recognize as wheat rust, fig blight, insect galls and other of the more strikingly conspicuous plant ailments. Such references are more abundant in the literature of the seventeenth century, and in the latter part of that and the eighteenth century a few papers giving careful descriptions of malformations due to insect invasion appeared. Even the law was invoked to aid in combating the wheat rust in France as early as 1660. Prior to the nineteenth century, however, knowledge of plant diseases can hardly be said to consist of more than mere observation of the fact that such diseases occur, and the little real knowledge that did exist was swamped by rampant superstition.

It is natural that the first attempts to explain imperfections were founded upon climatic and soil relations. Vestigial beliefs prevail to this day throughout the country among the untutored to the effect that the various blights, rusts, rots, mildews, etc., are caused solely by untoward conditions of weather, or the unpropitious position of celestial bodies or some other occult influence.

The significance of one great factor in the production of plant disease, namely the parasitic fungi, remained quite unrecognized until the second decade of the nineteenth century. Fungi had been seen upon the plant and had been described in some detail during the preceding decade, but instead of being recognized as causal agents of disease they were, as was the fate of bacteria in the case of animal diseases, by many regarded as products of disease. Before the study of plant diseases could be scientifically undertaken, the basic facts of plant nutrition were to be discovered, the parasitic habit of the fungi proved, the minute anatomy of the plant disclosed. Epoch-making in the disclosure of these desiderata, which may be said to have given birth to plant pathology as a science in the second decade of the nineteenth century were the investigations of the early Dutch, French, German and English botanists. Like bacteriology, plant pathology is an infant science of the last century, owing its being to the perfection of the microscope.

In the last two decades of the last century, scientific effort concerned itself chiefly with accumulating knowledge concerning fungi and insects. Vast numbers of these were classified, catalogued and described. In other words, the means of diagnosis were perfected and diseases were grouped into natural classes according to their causal agents. Attempts toward the development of methods of treatment by the use of various sprays were more or less effective. Indeed, spraying had been advocated to some slight extent for a century or more as a remedy for insect and other plant diseases. The variety of spraying substances recommended ranged from clay, ashes and cow manure to sulphur, lime, salt, etc. One writer recommended "The applying around the base of the tree; flax, rubbish, sea weed, ashes, lime, sea shells, sea sand, mortar, clay, tanner's bark, leather scraps, etc."—evidently not a homeopathic prescription. The variety of substances recommended raises suspicion that the efficiency of no formula was demonstrated. In 1787 we find the heroic advice, 'just wet the trees infested with lice, then rub flowers of sulphur upon the insects, and it will cause them all to burst.' Some decided progress was, however, made. As early as 1842, a whale soap was used and retained favor; quassi, hellebore and tobacco were standard insecticides as early as 1855. Sulphur was used for the mildews and bluestone for wheat smut.

The last twenty years of the nineteenth century mark the beginning of a new epoch in plant protection. For this there are three reasons: first the increased aggressiveness of a certain fungous disease, the grape mildew, in Europe; second, the rapid spread of the potato bug, somewhat pedantically termed the Colorado beetle, and, third, resulting from these two, revolutionary changes in materials and methods for treating plant diseases, both fungous and insect, in the new world and in the old. It is a matter not entirely without interest that the revolution in European methods may be definitely traced to typical American aggressiveness, inasmuch as the activity arousing fungus was of American importation.

In Europe the invasion of the downy mildew of the grape in 1878 was unchecked by the most vigorous fungicides then used. All are familiar with the story of the great benefit conferred upon humanity through the predatory habits of the French boys in the vineyards that produce the famous Bordeaux wines. The rows lying nearest the roadway were sprinkled with verdigris or a mixture of lime and bluestone, to give the impression that the fruit was poisoned. In 1882 Millardet, of the faculty of the sciences, noticed that the vines thus treated held their leaves while others succumbed to the mildew. He ascribed this effect to its proper cause, and conducted carefully systematized experiments, which resulted in giving to the world *bouillie*

bordelaise, Bordelaiser Bruhe, or Bordeaux mixture, a proved fungicide of great efficiency; one that has not yet been surpassed.

In the new world the extension of the potato belt westward connected the eastern potato belt with the region of the native food plant of the familiar potato bug. Finding the potato plant a more abundant and wholesome food than the wild solonaceous plants that it had formerly fed upon, the potato bug began its eastern migration. In 1859 it was found east of Omaha City, in 1868 it had reached Illinois, in 1870 Ontario, in 1872 New York and in 1874 it was upon the Atlantic seaboard. The potato bug ate ravenously and man was stimulated to new activity in the search for more effective means to overcome insect pests. The use of Paris green and London purple followed as a direct result of this stimulus.

The development of efficient fungicides and insecticides in Europe and America led naturally to the perfection of the machines used in applying these mixtures, and not the least important part played in the development of a practical plant pathology is concerned with the evolution of spraying machines. The first sprayer consisted of a bunch of switches. This was dipped into the spraying mixture which was distributed over the foliage by vigorous shaking. It gave place to an improved spraying broom or brush with hollow handle, the liquid flowing from a reservoir to the brush, from which it was applied to the leaves. Sprayers and pumps followed in turn. Then came the improvement of the nozzle.

We may recognize two periods in the development of plant pathology: the first or embryonic period extending from prehistoric times to the beginning of the truly scientific investigations in the middle of the eighteenth century, and contributing chiefly observations, collections, descriptions; the second or formative period, during which the foundations of the science were laid, the chief factors of it determined, and the chief lines of future progress marked out.

It is in no way my purpose to call attention to the part the Carolinas have played in botany as a science, yet I can not refrain in passing from mentioning that prominent place in the history of American mycology is assured to de Schweinitz, a minister of Salem, N. C., who in 1818 published the first important paper on American fungi; to M. A. Curtis, a tutor in Wilmington, N. C., who in 1830, with Berkeley in England, described many fungi of the Carolinas; to Ravenal, of South Carolina, the first to publish exsiccati of American fungi, and to Louis Bosc, of South Carolina, who published a descriptive list in 1811.

The embryonic and formative period prepared the way for the third period, beginning about 1885, which may be called the period of growth. It is marked by the development and perfection of the

rudimentary principles and discoveries of the preceding periods. It was during this period that the most spectacular conquests were made; that popularization and extension of methods occurred. So great, so numerous, so wonderful were the advances made during the past decade, that we frequently see the statement that little or no progress had been made in plant pathology prior to 1885. The present day student should, however, bear in mind that it was the persistent, arduous, patient work of the preceding years that rendered possible the progress of the closing years of the century.

My denomination of this period as 'the period of growth' indicates the nature of the changes which it inaugurates; growth in every direction and concerning every phase of the subject. There has been growth in the list of plant maladies. New diseases have been discovered by scores, and old diseases have been found to affect new plants, and diseases hitherto insignificant have taken prominent places as dangerous foes. The alteration of the plant constitution by high selection and breeding, the bringing of plants into new climatic or soil relations, the more intensive cultivation, the bringing of a susceptible plant into a region where a parasite is already growing upon one of its botanical relatives, thus exposing it to a possible new foe, are conditions that operate to admit of the evolution of new diseases. The growing of plants in large quantities in solid blocks, rather than sparingly in scattered gardens, brings about a congested condition comparable with the crowding of our cities, and favors the development of epidemics* by furnishing abundant material for the parasitic organisms to attack, abundant nutriment upon which they may multiply, and abundant opportunity for them to reach new hosts and spread the contagion. With potatoes, for example, raised merely as garden crops, the probability of an epidemic affecting the majority of gardens is not so great as when potatoes are raised in vast fields. A single field crop, once infested, so contaminates the air with spores that other fields are almost sure to become infected. The contagium becomes sufficiently multiplied to break the quarantine, and a general epidemic results. Any factor which tends to increase the occurrence of epidemics may quickly raise a given disease from obscurity to a position of commanding importance. So too does the increase in value of hitherto comparatively insignificant crops. The pecan and cranberry are at present objects of particular solicitude by the plant physician.

With the importation of plants from foreign countries and the transportation of plants from one part of the country to another comes

* The use of the word epidemic in relation to plant diseases while etymologically incorrect, seems justified since no other word conveys the desired meaning and the meaning of this word is clear to all.

the possibility of increased disease transference. Recent years have seen the San José scale spread from the Pacific to the Atlantic; the asparagus rust from the Atlantic to the Pacific; the hollyhock rust has invaded us from Europe; the chrysanthemum rust from the Orient; the watermelon wilt is now moving northward and the peach yellows southward. In nearly all cases where the soil is diseased the affected region is annually enlarging, so that soil diseases a decade ago insignificant in the territory of their occupation are fast assuming control of alarmingly large regions. The growing of plants in larger quantities also increases the amount of germ-bearing refuse to the ultimate end that the very air and soil become germ laden.

Civilization, higher culture and community life, especially if it verge upon congestion of population, exacts an inevitable forfeiture by increased mortality. Thus does the list of diseases that comes within the horizon of the practical men enlarge. Wonder, often skepticism, is expressed at the existence of unfamiliar diseases of man, other animals and plants, as though these afflictions were conjured up by the imagination of the over zealous practitioner. The increase of affliction is more apparent than real, as it is in the case of appendicitis, which is now recognized, named and cured, consequently, heard of, whereas under the old régime it was not recognized as a distinct disease, therefore it was unheard of, though the patient died. Parallel cases might be cited among the plants.

The work of DeBary on polymorphism among the fungi is being extended. Knowledge of the life histories of various pathogenic fungi is being slowly expanded. Summer forms are connected with winter forms, and thereby the hibernating condition, often the most vulnerable point of attack, exposed. The discovery of heteroecism in the rusts, the alternation from wheat to barberry, from apple to juniper is of classic antiquity in the annals of plant pathology. It emphasized the need of close study of life histories of all parasites. Such study has given abundant fruit, notably in disclosing the relation between the apple cankers and the ripe and bitter rot of the apple, and revealing the winter condition of the brown rot of the peach. The lead so fortunately made in the discovery of the Bordeaux mixture has been assiduously prosecuted. The original Bordeaux mixture has been greatly modified, changed, indeed, from a thick paste to a thin solution, and so thoroughly tested in all its modifications, that it has now probably reached its ultimate perfection. Hundreds of other chemicals, both dry and wet, have been tested as fungicides, with the adoption of a few adapted to special conditions, *e. g.*, sulphur and sulphides for powdery mildews and the ammoniacal copper carbonate for use as the fruit ripens, thus avoiding unsightly spotting. A happy combination of insecticide and fungicide has been found in the various

sulphur washes. There has been very remarkable growth in the perfection of spraying appliances; pumps and dusters of many kinds are upon the market. Particularly is the improvement in nozzles to be noted. Nozzles constructed upon scientific principles, capable of applying the liquid in the form of the finest spray to the tops of the highest trees. In the place of the old hand pump and pail, we find barrel pumps on wheels, tanks on wheels with pumps operated by gearing attached to the wheels, and finally for the larger fruit farms and for municipal care of shade trees are multiple pumps driven by steam power.

The treatment of seeds to kill adhering spores has been improved upon in many details. It illustrates especially well the nature of the development during the present epoch of plant pathology. Originally the treatment for wheat smut was based purely upon superstition. Pliny, for example, says that 'if branches of laurel are fixed in the ground the disease will pass from the field into the leaves of the laurel.' Tull in 1730 says that there are but two remedies proposed, brining and changing the seed. The avoidance of certain kinds of manure because of their effect upon the host plant and because they carried the smut spores was also advocated about that time. The scientific demonstration by Brefeld that the plant is susceptible only when very small, gave rise to the thought that by hastening the early growth the period of susceptibility could be shortened, and methods of planting and tilling in accord with that idea were advocated. In addition to cultural methods mechanical treatment of seeds, such as passing the wheat loosely between millstones, violent fanning, etc., were suggested about 1786. The chemical treatment of seeds, says Tull, was accidentally discovered about 1660 by the sinking of a shipload of wheat at Bristol, and afterwards, finding it unfit for breadmaking, it was used for seed wheat. The following harvest in England was very smutty except in the case of this accidentally brined seed, which made a clean crop. Then followed brining with liming and liming without brining, soaking in lime, arsenic, salt, arsenic and lye, and various other treatments, none of which, however, came into general use. Accident coupled with acumen again aided in hastening a discovery. Provost while attempting to germinate some spores placed some of them in water distilled in a copper vessel. These failed to germinate, though similar spores placed in water which had not touched copper germinated well. Following this lead he and numerous other investigators experimented extensively with copper compounds during succeeding years.

Such is the history of the development of a treatment effective for smut of wheat and barley, but not for that of oats. The next marked advance was made by Jensen, a Dane, who in 1887 developed the famous Jensen hot water treatment, a treatment which though re-

quiring considerable accuracy of manipulation was thoroughly effective. This method, if no easier were to be had, was well worth to practical agriculture all that the experiment stations of the world have ever cost. Within only a few years, however, the Jensen treatment was supplanted by the formalin treatment; a treatment so simple, inexpensive and effective that, save for minor improvements of detail, the end seems to have been reached in the search for preventives for the particular diseases to which the method applies.

Growth of knowledge concerning bacterial diseases has occurred, beginning with the pear blight which baffled all horticulture prior to the assertion of its bacterial nature by Professor Burrill. The proof that bacteria can and do cause plant diseases has been definitely adduced, and a large number of such diseases have been recognized upon many plants. Not only from the scientific side have these ailments been studied, but from the practical as well, and preventive and palliative measures have in many instances been found.

The soil is often spoken of as the living earth. Not only may it live, but it also partakes of those chief accompaniments of life, viz., health, sickness and death. A healthy soil may, from an agricultural point of view, be regarded as one capable of fulfilling all its vital functions; a sick soil, one in which some such functions are impaired. Of only one class of soil sickness may I speak, namely, that which results in producing sick plants by harboring pathogenic germs. The cotton wilt, the Texas root rot, the watermelon, tobacco, tomato and cabbage wilts, the cabbage club foot and the onion smut are conspicuous examples of disease so propagated. Diseases of this type not only destroy the crop, but they preclude the possibility of successful culture of the plant in question, or of its close botanical relatives for many years. Such foes to agriculture have completely destroyed the possibility of tobacco growing on many farms otherwise eminently adapted to this crop and ill adapted to any other, resulting in great depreciation in the value of the land. This encroachment upon valuable soil will proceed yearly, and with geometrically increasing rapidity, until means of prevention are discovered, as they have now been in some instances, and the method of prevention becomes common knowledge. Soil diseases, the most dreaded of all dangers to the plant, are prevalent to much greater extent in the south than in the north. One field is known to exist in South Carolina upon which neither melons, cotton nor cowpeas can be grown. It is conceivable that many other germs could infest one and the same field, but no greater affliction concerning such staple crops seems possible.

Growth in popular appreciation of the importance of plant diseases and of the value of remedial and prophylactic measures is perhaps the most striking characteristic of plant pathology in the last twenty years.

At the beginning of this period spraying was in no wise general. It was of rare occurrence. Man suffered unresistingly the attacks of the molds, mildews, rots and blights. The circulation of thousands of state experiment station bulletins and similar bulletins from the national department of agriculture, the vigorous campaign of farmers' institutes, farmers' reading circles, farmers' extension courses, and the extended use of farmers' periodicals and agricultural papers have served to bring the latest discoveries of science to the use of him who will heed. As is to be expected, it is the man who most closely studies his business, he who has most at stake, the large specialist in the culture of any crop, who first embraces the offered aid. The large orchardist or vineyardist leads the way in the adoption of new methods and new machinery. The revolution looking toward recognition of the value of plant treatment is now so thoroughly inaugurated that the treatment of such diseases, both insect and fungous, in the case of fruit and trucking crops is of general occurrence. The movement, too, is world-wide.

The practical outcome of all the investigation and propaganda up to the present time is that many hundreds of plant diseases have been recognized; for a hundred or more have been prescribed remedial or preventive measures, many of which are eminently successful; witness, the treatment of cereal smuts, the peach curl, the grape black rot, the powdery mildews. The saving occasioned by any one of these, as is true of scores of others, would amply suffice to pay all the expense of investigation and propaganda incurred in the development of the whole field of plant pathology. By oat smut alone the estimated damage in the United States yearly is $26,766,166, a loss avoidable by an annual expenditure of less than four cents an acre. The saving actually made in Dakota, Minnesota and Wisconsin in one year is placed at $5,000,000.

The future problems of plant pathology are manifold. The period of growth must continue long before the work now undertaken is done. Many diseases of even the cultivated plants are not yet recognized. The diseases of wild plants, particularly the weeds, must too be studied to ascertain the possibility of intercommunication of diseases between weeds and crop plants. The life histories of all disease producing fungi must be closely studied, particularly to determine their hibernating condition. As yet the merest beginning has been made. The interrelation of host and parasite must be studied, the periods, points and modes of infection made known. The biology of the fungi, their life habits, conditions of spore formation, characters of growth, relation to light, heat, moisture, nutriment, etc.; their resistance to adverse conditions, their longevity under various conditions of environment are all problems of ultimate practicality. The question of species is unsettled and the

recent demonstration of biologic varieties among the rusts, mildews and fusariums opens a large and important field of research. The agencies operating as disease distributors, the wind, insects, soil, man, water or what not must be known that such distribution be more readily controlled. The causes of resistance and susceptibility to certain diseases rest in obscurity, except in a few cases where the responsibility has been fixed upon some particular structure or chemical. The breeding of plants resistant to specific diseases not readily amenable to other means of control must proceed. Such work is now in progress with cotton, melons, tomatoes, tobacco, grains, flax and other plants. The relation existing between many root fungi and bacteria and the roots they inhabit remains to be studied. Aside from parasitism there is also mutualism, a kind of beneficial disease falling to the province of plant pathology. It needs much further study.

Specific problems also abound, the peach yellows and rosette, the mycoplasm theory of rusts, the grape Brunnisure. Differences of opinion now exist or the technique or scientific data are insufficient for an adequate solution of these questions and many other similar ones. Work on timber protection, while not strictly a question of disease, but rather a post-mortem problem, falls to the lot of the pathologist for the want of a more appropriate place. That intensive study of a disease, however thoroughly it may seem to have been studied before, may lead to important development is well illustrated in the case of the familiar pear blight, which, though known for ages and the topic of masterly classic research, has recently, under trained observation and critical interpretation and experimentation, revealed new secrets leading to more masterful and complete control. The large fields of plant pathology, grouped under the term 'physiological disorders,' are still practically unworked; diseases due to false nutrition, absorption or assimilation, or to impaired carbon assimilation owing to improper environment, to crowding or shading or to hereditary inabilities. A start has been made sufficient to show the importance of the results awaiting.

The recent discovery of the so-called ultramicroscopic organisms or filterable enzymes which has robbed the bacteria of the distinction of being the smallest of living things opens a new field in both plant and animal pathology comparable in kind, though probably not in magnitude, with the creation of bacteriology by Pasteur. It is yet unknown whether we have to do here with organisms or enzymes, and contemplation of the problems awaiting in this realm places us in a position to appreciate more fully than ever before the great controversy of spontaneous generation as fought in the sixties. The announcement in a recent periodical of the discovery of soluble protoplasm emphasizes the existence of a vast unknown covered by the words protoplasm,

enzymes, invisible organisms. Is it coincidence of fate that with the growing importance of the problem of the invisible organism there comes the invention of a microscope of surpassing excellence with which the seeing of molecules is a hoped for possibility?

The science of plant pathology is indeed young. It has yielded much, and it is still full of promise. In the achievement of the results to come draught will be made upon the sister sciences even more than in the past. Plant physiology waits upon chemistry; plant pathology upon plant physiology, and chemistry in return receives valuable contribution from both. Mathematics, physics and geology all contribute to the general upbuilding. The sciences, though becoming more divergent instead of becoming more independent, are yearly becoming more dependent, each using the discoveries of the others to gain new foothold or new tools in the search for truth. Often it is the frontier territory lying between two sciences which, belonging distinctively to neither, is least worked, and therefore presents most promising territory for conquest. Such is the history of the comparatively new sciences of physical chemistry, physiological chemistry and biometrics.

Nor does the field belong exclusively to either the devotee of pure science, so-called, or of applied science. The study of problems seemingly most remote from any practical ends has often proved fundamental in the upbuilding of vast industrial growth. Bacteriology was born of crystallography. The father of galvanic electricity was derided as the frog's dancing master. Nor does the avowed object in view give a sure key to the ultimate outcome. Alchemy, though never attaining the end sought, hastened immeasurably the era of industrial chemistry. Nor may it be said that applied science is inferior, for without the application the fundamental principles are of no avail in the promotion of the welfare of man.

Intensive laboratory study with no object other than the increase of knowledge of molecular construction has led to the commercial production of many important compounds. The present oat smut treatment by formalin owes its practicability equally to pure science in the chemical study that rendered the production of formalin practicable at moderate cost, and to pure science of the botanist who from mere interest in fungous growth discovered the nature of parasitism, and to the practical scientist who applied the knowledge of the chemist and the botanist to the solution of a definite agricultural problem. The distinction between pure science and applied science is invidious. It is not a difference based upon the nature of the knowledge; rather upon the motive of the worker. All true science is practical, either remotely or directly, and the man of applied science is but completing the work of the pure scientist. Especially does the future of plant pathology rest with both.

SLEEP AND ITS REGULATION.

By Dr. J. MADISON TAYLOR,
PHILADELPHIA, PA.

SLEEP as a factor in physical economics ranks in importance with respiration and digestion. Those who live normally, who throughout all ordinary exigencies maintain a natural attitude toward life, its strains and reponsibilities, may expect to enjoy a full measure of this restorative function. How much each one needs is not to be determined by dogmatic rules or precedents, nor does each one require the same amount under every condition or circumstance. There must be enough, daily and weekly, and of suitable character, to restore the balance of neural energy reduced by whatsoever of fatigue follows upon daily activities; otherwise the sensorium resents this deprivation in one way or another. Individual needs vary and can only be determined inferentially, giving due weight to generally accepted requirements.

Sleep, being the completest form of rest, is needed most by the youngest and least by the oldest. Most sleep is required by the weakest and least by the strongest. During childhood and exhaustive states too much sleep is rarely possible. For those in full tide of vigor too much sleep is often distinctly hurtful. Many modifications will immediately suggest themselves to those who are wise or learned in the science of bodily growth, development and disorders. Experience always counts for much. Variants, sometimes wide, are often permissible. Large errors will arise when these qualifications are marred by caprice, taste, prejudice; and harm follows, of one sort or another, sometimes of serious degree, by obscuration of sane reasoning on what may seem to be obvious and simple facts.

Physical efficiency depends chiefly upon the kind and amount of effort expended. Rest is an inevitable corollary. Relaxation is the starting point of all effort. For example, the strongest blows, the most accurate thrusts, can only proceed from an arm in thorough equipoise. Equipoise presupposes a full quantum of energy. Animal energy depends upon adequate rest as much as on force-giving foods. Complex acts, conditional always upon harmonies between intact central nervous dynamos, and well-adjusted mechanisms, can only be performed in their completeness when forces are at the norm.

Sleep is an absolute necessity for conscious beings. There are those who oppose this view, and some require relatively little, and that,

too, for long periods. Some sleep lightly, retaining in greater part their consciousness. Occasionally we hear of an individual who has lived for a long time without sleep, so far as can be determined, and yet has continued to maintain good health. Sufferers from one form or another of nervous exhaustion are often compelled to forego sleep temporarily. Vigorous persons of pronounced personality and highly developed consciousness have the least need for sleep, at least while at the zenith of their powers and in the full flower of energizing.

The maintenance of conscious life demands an expenditure of energy so intense that the processes of nutrition and reconstruction of cellular waste can not be carried on without sleep. Complete repose of the consciousness is demanded for the plastic nutrition of the organism and the accomplishment of vegetative life. Consciousness is the highest of our faculties, rendering possible moral and scientific ideation; it demands the greatest efforts of our organism. In its absence sleep is less required.

All the internal organs are, during sleep, relatively less filled with blood because then the skin is in a state of hyperemia or gorged with blood. The sweat glands act more energetically at night whether we are asleep or awake, hence the danger of chills is then greater. All the organic activities continue, but are less vigorous at night, and during sleep, whereas during sleep in daylight hours these proceed with little alteration. When animals or men feel the desire to sleep they instinctively seek a quiet sheltered spot, as free as possible from light and noise, thus avoiding whatever impressions from the external world are liable to be subjectively translated into sensations. The eyelids are lowered; a position is sought wherein the muscles can be fully relaxed. The sensorial organs are capable of acting during sleep and continue to transmit impressions into conscious sensations.

With the pallor of the brain, which occurs in sleeping animals, the cortex ceases to react so readily to mechanical, photic, electric or other stimuli. The spinal cord and sensory nerves do not sleep, yet sensations of pain are then lowered. The nerves transmit painful impressions, but the consciousness of the sleeper perceives them incompletely. The voluntary muscles become quiescent during sleep, but retain their power, as shown by the normal subject in changing position, arranging the bedclothes, even walking; soldiers are able to march or ride while asleep. The brain is the chief part which sleeps, but it is not wholly inactive, exciting inhibitions which check the formation of reflex movements. If stimuli are applied of sufficient intensity to overcome the protective states of the somnolent consciousness the subject awakes, recognizing the cause more or less certainly.

Sleep is not an absolute arrest of cerebral activity; the brain then retains always partial energy. In deprivation of sleep it is the brain

which suffers most, while in deprivation of food it is the brain which preserves longest the integrity of its structure and function. In young animals, abundantly fed and cared for but kept awake, there follows serious lesions of the organism which soon become irreparable, and death results.

There have been many theories and hypotheses advanced to explain the phenomena of somnolence. The physiologists have here, as so frequently elsewhere, exhibited far more academic than practical interest in the matter. There is no subject, however, of greater importance, since it is a prime factor in all the reparative phenomena of life, standing at the foundation of nutrition; yet no research work has been done on the nature of sleep commensurate with the gravity of the subject. Psychologists have written extensively on one phenomenon of sleep, viz., dreams. Normal sleep has attracted so little attention that we do not know exactly how to modify it in accordance with common conditions of bodily derangements. Inferentially certain facts seem established which not only account for the phenomena of sleep, but enable us to reason from them and thus to regulate the state in great measure; sometimes sufficiently. It is probable that during sleep there is a diminished resistance in the surface vessels, inducing lowered blood pressure, hence smaller amounts of blood pass through the brain. As sleep approaches the cerebral vessels grow relatively less filled with blood for an hour or more after full somnolence has come. After reaching its minimum tension the brain circulation remains practically constant for one or two hours or more, gradually returning to normal as the time for awakening nears.

After having attained a fair idea of what sleep is, whereby we can better appreciate a reasoning from our individual standpoint, we may proceed to discuss its regulation. For the young, who may be assumed to be in possession of full neural and circulatory balance, whether in or out of health, the regulation of sleep is a simple matter, one which will in most instances adjust itself if the subject be placed under normal conditions.

We may fix our attention most profitably upon the status of sleep in those of middle or late life. Here a number of causes conspire to disturb equilibrium of body cells, sometimes slightly, and at others it will be found that effects have been insidiously wrought which may suddenly obtrude upon our attention, causing great distress, often impairing the integrity of our judgment, hence our working efficiency. Therefore a double peril assails. Mere inability to sleep naturally, or as heretofore, or as each one assumes as a right, is, especially among men (who shrink from admission of physical weakness), seldom regarded as worth their seeking the advice of a physician. Whereupon the simplest remedy is to hunt about for something which will obtund

the consciousness. Often this is a form of alcohol. A friend will advise a glass of whiskey at bedtime, may be two or more; beer is popular for this purpose; some special form of wine is often recommended, and (deplorable as it may seem) too often by the physician.

The entering wedge is so easy, and in the main agreeable in its primary effects, that the habit of tippling is thus readily established. Or again the chemists' shops are filled with 'simple harmless remedies for insomnia.' The sign boards in all public places glisten with advice. Every acquaintance is ready with counsel, especially those numerous well intentioned women with little else to do but to prattle of their shallow convictions on matters coming within the narrow range of their experience, medical, spiritual or social. It is never safe to play with drugs; to trifle with agencies often hurtful to a profound degree in their ultimate effects. Idiosyncracies exist, too, whereby what may harm one not at all produces in another far-reaching derangements of vital organs. One of the most dangerous lunatics I ever saw was a man possessed by sudden homicidal tendencies. He would have remained so had not it been discovered, by providential accident, that he was accustomed to use habitually moderately large doses of some bromide. The obsession promptly and permanently disappeared by total withdrawal and the use of an antidote. We physicians, especially those who see many instances of nervous derangements, are constantly coming in contact with the deplorable derangements caused by hypnotic drugs, many of which are ordinarily classed as innocent. The action of narcotics presents none of the characteristics of normal sleep except the temporary arrest of consciousness; hence narcosis is not true sleep. It does not refresh and regenerate vigor as does normal sleep. To be sure, drug unconsciousness may and often does pass into sleep. Again there are those who have become so accustomed to narcotics that, when deprived of them, they can not sleep. This would seem to prove a sort of antagonism between the drug effect and natural sleep. In brief, whatever agents inhibit cerebral activity, inducing local anemia, hence permitting sleep or narcosis, are harmless provided they do not derange nutrition or cause other ill effects. All narcotic drugs invite these evil effects in varying degrees and hence are to be avoided, and only used in extreme cases and under guidance of a competent physician.

The other peril lies in the fact that derangements of sleep often foreshadow serious structural damage of the heart, arteries or other organs or tissues. Hence unless the phenomena be estimated intelligently, in the light of other than obvious data only to be secured through careful medical examination, a deadly disease process may escape detection until too late to accomplish full repair.

To secure regular consecutive sleep it is best to assume that posi-

tion which is most natural and best suited to invite the least disturbance of the functions of the great organs. To use the analogy of the four-footed animals, and by such facts we can secure the safest guidance, the best position is on the abdomen or nearly so. Habits may, and do, vitiate our instincts here as elsewhere, and we can accustom ourselves to many departures from natural and advisable operations. This is especially forceful while in vigorous health, but we are speaking here of securing the best rest with the least tax upon our organism, hence it is well to determine those means which are normal, and employ them. The body should lie as nearly as possible on a level, head and feet as well as body, on the side inclined toward the abdomen, adjusting arms and legs in such a fashion as shall not permit undue pressure upon nerves and bloodvessels, direct or indirect.

To lie on the back is objectionable for the reason that long continued pressure on the tissues adjacent to the vertebral column, which are innervated by the posterior primary divisions of the spinal nerves, exerts a continued irritation through vasomotor connections to the viscera, disturbing the circulation in the segments. Here are the cell bodies of the vasomotor nerves, which thence pass to the organs and beyond parts, thereby governing function. Thus, dilatation is induced and maintained in the blood vessels of the viscera. Also certain results follow directly by effect of gravity. Pressure on the abdominal organs, and their varying contents, is exerted upon the great vessels, arterial, venous and lymphatic, the sympathetic plexuses, and the ebb and flow of fluid in them is deranged. Hence function and nutrition of these structures are influenced unfavorably. Man is the only animal which sleeps on the back. This attitude should only be assumed for short periods. During extreme weakness this position is often taken, but it is the duty of attendants to urge a frequent change to the side, otherwise several hurtful effects may follow, among which the least grave are nightmare and evil dreams. The poisons of katabolism circulating in the blood tend to be deposited in the outlying tissues; hence arise pneumonia and bedsores. Not only is this true for those who are suffering from one or another form of disability, but for those in robust health, especially when sleeping on the back after full meals. Many obscure forms of digestive or circulatory disorders may have been initiated in infancy through lying too long upon the back.

In animals, among whom such disorders are rare and whose spinal column is constantly horizontal, there is little or no change in the relative positions of the great organs at any time. In man, who is constantly altering the relationships of these viscera by lying, standing, stooping, the blood supply and venous return are subject to frequent interruptions, and strains are exerted upon the supporting structures

of the blood vessels and thus the vasomotor mechanisms are taxed heavily. The head should be permitted to rest as nearly upon a level as the feet, though most people prefer some support. The blood should be encouraged to reach all parts of the body equally, hence the limbs had best be extended, not flexed; the habit of extending the arms above the head is a particularly bad one.

To secure the most perfect repose the temperature of all parts should be equalized before retiring. Cold feet induce delay in securing sleep and it is then shallow when attained. The bladder and bowels by weight of their contents will interfere with repose, hence they should be previously emptied. It is most unwise to overfill the stomach before retiring; this disturbs sleep almost as much as hunger, but moderate eating before sleeping is not hurtful, and is often salutary.

Sleep is only a function; therefore, whatever disturbs it depends on structural derangement of some sort. Disorders of sleep are manifold. The commonest are psychic exaltations or depressions, worries, brooding on the cares of the day, continuing to dwell on the waking problems. Habit is ever forceful. A well-trained mind will promptly shut off or readily let go of the thought processes. Unnatural activity of the sensory and association centers causes dreams; that of the motor centers results in shocks, starts and spasmodic phenomena. Control of the visceral centers may become inhibited, permitting unconscious discharges from the bladder, intestines or sexual organs; innervation of the lungs or heart being thus deranged, palpitation or dyspnoea is induced. Sensory centers being over-stimulated, sensations of light follow, or of sound, also pain or vertigo. "In fine, the ordinary smooth current of the subconscious activities breaks against some pathologic states and now one symptom, now another, is thrust out and so unpleasantly that the sleeper awakens" (C. L. Dana).

A review of Dana's remarks on the disorders of sleep will be useful to achieve an understanding of the varieties and phenomena of insomnia; a better term perhaps would be difficulties of sleep. Some people, especially those of middle age, fall asleep easily, but wake in the small hours and thereafter only doze fitfully. This may be due to beginning degenerative changes in the arteries, connected with the effects of worries and strains, or only a habit, or echo of youthful customs of early rising, or an acquired weakness or irritability of the heart. Others fall asleep readily, but are soon disturbed by little explosions of motor, sensory or psychic forces. The body or limbs start or jerk; sleep follows, but these nervous explosions may be repeated two or three times. It is usually the result of exhaustion, psychic or muscular over-tension, physiologic irritability, indigestion, nervous fatigue, or may foreshadow some serious derangement. Sudden awakenings often betray emotional distress, fear or disorders of ideation.

Weir Mitchell has written fascinatingly of disorders of sleep, making absorbing reading for the profession as well as the laity. He it was who described first the sensory shocks, strange feelings passing along the body, culminating in some abrupt explosion, noise, odor or vision. Vertigo is occasionally thus experienced, especially by those who have felt it before. That mysterious malady called 'migraine' sometimes occurs suddenly while asleep 'and hales the sufferer from profound sleep to waking hours of misery.'

Morbid or perverted sensations, numbness, 'pins and needles' formications and such like mild neuroses appear at times during sleep. Limbs may seem 'dead,' sensation being temporarily lost and not in any way which follows upon marked pressure interrupting the flow of nervous impulses, but purely a phenomenon of sleep. These are more common in the later hours of night, when the motor cells are restored in part, losing irritability, the sensory cells being still excitable. These discomforts may be referred to interruptions in the conductivity of the spinal cord. Nocturnal psychoses, the night terrors of children, nightmare, strange mental vagaries, changes in intellectual and emotional balance, are of such wide variety that they can only be alluded to; each person of rich experience is able to recall instances. In these conditions of distress much folly can be committed, and frequently is; evil thoughts are thus engendered, which too often influence action later. Sometimes imperative impulses arising in slumber drive one to commit questionable or silly deeds. The imagination in some is thus stimulated to utter weird statements, or to put on record what are falsely estimated to be thoughts of deep significance. I recall reading an incident in the early official life of Bismarck, who often thus wakened in the night with the conviction that he had solved perplexing problems. On reducing to writing the ideas thus excited he found, on perusal next day, that they were altogether fanciful. It is true, valuable ideas do come in dreams or in real temporary waking states.

The sleep of early life is peculiarly sensitive to irritations of the organs below the diaphragm, digestive or genital; in later life to those above, of the heart, blood vessels or lungs. In this connection we may refer to dreams. The suspension of brain activity in sleep is only partial; there prevails a certain amount of psychic life. Every nervous stimulus, sensation or idea leaves an impression, a trace, in the cerebro-spinal system. Obscure motions, influences, irritants generated in the organism, may afterward revive temporarily under some impulsation of consciousness, as by afflux of blood. Each cell of the body is endowed with more or less memory (Henle), for by this means are preserved hereditary influences, the transmission of psychic and mental characteristics, the after images of sensations. In this manner many sounds, sights, feelings, which are partially conveyed to the sensorium,

may become revived and variously interpreted to the consciousness. Predormitial sensations, thoughts and movements are thus capable of inducing multiplication and diverse auto-interpretation. Dreams grow luxuriantly when the state is one of partial wakefulness. The influences of the day are then woven into fanciful pictures more or less reflecting actual life.

If sleep be profound the imagination is no longer dominated by actualities and there arises the phenomenon of a special world, that of dreams. Mental activity is really physical activity; hence we may experience consequential fatigue. At the bottom of the emotion may be found a subjective excitation of the peripheral nervous apparatus. This form of reflected life constitutes the basis of dreaming, the imagination, hallucinations, the realm of fancy. Dreams have their origin in those parts of the organism most active in the waking state, in eyes, ears, the tactile, temperature and muscular sense. The same obtains as to hallucinations in the insane. A very deep sleep does not permit of dreams, or the waking memory can not recall them, whereas in very light sleep dreams are frequent and can be remembered.

Dreams are more numerous and picturesque among intellectual people, and during certain exhaustive states, and less among those of lower mentality. The more primitive, young and intellectual the person, the more illogical, disjointed and elementary are the dreams. In old age, and profound depressive states, dreams are most rare; they serve many useful purposes. To the physician certain features of dreams possess a valuable significance. They exercise a salutary influence upon otherwise unused areas of the brain and permit the excursions, or, may be, formation, of the faculty of imagination (Manaciene). They act as a defense against the monotonies and trivialties of real life, for without them we should grow old much more rapidly (Novalis). Many writers, poets, scientists, philosophers, musicians, etc., testify to the value of dreams in piecing out their concepts, idealizations, weaving a woof of imagination invaluable to the completed thought.

It will be seen that the regulation of impaired sleep reaches back to causes most varied. Some are slight and superficial; others are due to deep-seated derangements or lesions, beginning or established. In practise, however, certain plain simple procedures usually suffice to bring about happy results. Beyond what these can accomplish, skilled medical aid should be sought and a careful search made for definite disorders, and systematic measures instituted to remove them consonant with the difficulties encountered. It is well to remember that the causes of wakefulness may be highly complex; slight factors often acting with equal forcefulness with those which theoretically should be greatest.

We are concerned in our efforts to regulate the resting period of

the consciousness, with possible morbidity in two directions; too much or too little. Ordinarily it is assumed that the more one gets of sleep the better. This view is so generally accepted that the custom of some physicians, especially those who see much of illness in the extreme periods of life, to order food or employ active measures at regular hours, involving the waking of the patient, verges upon the danger line. Judgment must be exercised, and is well within the capabilities of a good nurse. Serious exhaustion has often followed needless interruptions of repose during exhaustive states.

It is entirely demonstrable that a variety of disorders may result from, or are indicated by, excessive somnolence, partly of developmental and partly of degenerative origin. During infancy sleeping must predominate over waking states, the unconscious reflex life over the conscious intellectual life. It should be remembered, however, that consciousness requires exercise for development. Monotonous measures, such as rocking, swinging, unmusical lullabies, may serve a salutary purpose occasionally, but can readily be carried too far, to the point of lowering normal temperature, inducing excessive anemia of the brain and disturbances of circulation. Sleep should come by opportunity, comfortable position and customary environment. Habits should be formed sufficient in themselves to invite repose. It ought not to be interrupted needlessly, nor forced by measures or drugs which obtund the consciousness. Normality of sleeping capacity is the product of intellectual equipoise. Stupid folk are proverbially dull, lethargic, with large capacities for deep sleep. Some part of this is no doubt the result of over indulgence. The consciousness is often enfeebled by disuse in young or old. In the young the impetus to exercise the faculties demands encouragement; also, as age enfeebles the brain structures, mental stagnation, hence degeneration, is invited by overmuch time spent in unconsciousness. Nutritive balance, the expenditure of energy, can not be maintained indefinitely. Renewals must occur, and it is shown that inordinate somnolence makes for exhaustion of body and mind; the kidneys suffer, their vessels become distended and hence enfeebled. In the aged the tone of the tissues, especially of the vessel walls, tends to become devitalized, leading to a stasis in lymph and blood vessels and to various forms of organic derangement. In deep sleep, long continued, this stasis of blood and lymph is unduly encouraged, sometimes to the point of paralysis. The bile becomes thickened, stagnated; the bowels, the intestines, suffer from a surfeit of sleep, impairing the machinery of peristalsis, hence follows constipation. The urinary organs also share in this derangement of elimination and gravel, calculi, may form. Anemias are often unaccountable, but it will be found that chlorotics usually sleep too much and are the better for its regulation.

There is no simple fact more forcefully borne in upon the writer than that early rising and movement in the open air before breakfast is a measure of vast importance in a large array of chronic ailments, especially those involving gout, dyspepsia, constipation, obesity and disorders of the sense organs. Many people aver that they are made miserable by rising early, stirring about before taking food, and consequently suffer from headaches, nausea, prostration and the like. These phenomena are the results of some derangements in the circulatory balance, most probably due to a morbid quality of sleep, which for the most part is remediable. In proof of this statement is the fact, usually clearly demonstrable, that if the physician can secure fair cooperation, with persistence all this wretchedness will disappear. Particularly is this shown if circumstances compel the patient to alter his habits for the better. Abundant illustrative instances could be cited. Weir Mitchell in his recommendations for the rest treatment, so valuable in the repair of profound conditions of exhaustion, compels a fixed hour for wakening, usually seven A.M. Often it has been the writer's duty to soothe and explain to Dr. Mitchell's patients, who resented being awakened, the reason for this regulation.

Disuse of muscle is followed by atrophy; so of other tissues. Strength can only grow by judicious, continued use. Witness the pitiable spectacle of steady degeneration in the tissues, in mental and physical aptitudes, commonly displayed in those of advancing years, who, through withdrawal of normal stimuli to exertion, permit their organs and their structures to fall into disuse. Prosperity, interpreted so often to mean cessation of energies, is often fatal to physical and mental efficiency. The antidote is simple and most effective, the retention of habits of usefulness applied all along the whole line of normal activities.

The whole range of bodily derangements and diseases can be interpreted through variations in the blood supply. This again depends upon the incidence of diverse irritants, infections from without or poisons generated within; or such as are the products of changes in the blood plasma effecting oxygenation.

Sleep being the relaxation, suspension, of the consciousness, the brain being the center of consciousness, it naturally follows that, as evidence shows, the circulation in the brain is, during sleep, at the lowest normal tension. Whatever disturbs sleep, therefore, probably induces an afflux of blood to the brain. It is evident that to sleep peacefully and continually it is important that the blood pressure shall be as nearly as possible normal. If this be markedly above or below par sleep is interfered with. Plethoric folk, however, supposedly of over-tense vessels, often sleep better than the feeble and weakly; yet they are more likely to slumber heavily, are difficult to wake, and on

waking suffer from morning confusion and headache; in short, are far less refreshed by their slumber and require longer to acquire waking balance than frail beings whose sleep is shallow, interrupted and seemingly insufficient.

All these facts and reasonings from vascular tone constitute a long, somewhat technical, story; suffice it to say that, in order to secure comfortable natural sleep there is demanded a careful regulation of blood supply and distribution. Where a careful regulation of life fails to accomplish this, help must be sought of a wise physician, who will promptly determine what is amiss. The difficulty may be found to be due to faulty skin action, cold extremities, intestinal accumulations, or visceral poisons, organic derangements, a weak heart, an overtired body, an overwrought brain or other physical disorders, the province of the physician. Interference with matters out of the realm of our experience is usually followed by punishment. Among the most dangerous things a person can do is to take a shot in the dark in medical procedures, swallowing medicines on blind guesses. Damage must almost inevitably result, first by deranging digestion, perhaps already at fault, and next achieving stupor, not true sleep, or encouraging the brain to demand meretricious, unsuitable soporifics.

While it is most desirable that sleep should be taken in regular amounts, at a suitable time, and this during the hours of darkness and continuously, still it is possible that various habits may be formed, seemingly peculiar, which suffice for ordinary requirements. These may be acquired to meet some temporary demand, or become habitual for years. For instance, mothers of young babies commonly form the habit of sleeping and waking readily and frequently, and yet continue to enjoy excellent health. Trained nurses acquire even more complex, yet systematic, habits of sleep and wakefulness; a regular irregularity, yet productive of little or no exhaustion, at least for a time. Persons engaged in diverse strenuous occupations secure a power of seizing sleep when they can get it, notably sailor men by 'watches' of four hours each, twice a day.

Sleep, being the chief restorative agency for the consciousness, the desideratum is chiefly to achieve enough repose in sufficient completeness to effect repair of brain cells and other centers of energy. In those whose lives are full of repeated and emphatic demands upon them for concentration of attention, the habit of taking short naps is found to be most refreshing and invigorating. Many physicians, some lawyers, and other professional men who pursue literary work, find it satisfactory to secure a brief sleep some time during the day, often in the middle of operations, when an opportunity offers. Thus a short sleep in a chair, or preferably lying down on the back on a bench or lounge, will rejuvenate the powers and permit intellectual work far

into the night. While a certain number of hours of consecutive sleep are imperative for full health, these can not be dogmatically determined except by carefully weighing circumstances, which vary. Lumber men on the 'drive' maintain excellent health on the smallest amount of sleep, during the most trying circumstances, after intense physical exertion so long as the spring daylight lasts, often wet to the skin, with little or no bedclothes or protection at night from freezing weather and fed irregularly, often insufficiently. Armies, exploring parties and others have similar experiences, and suffer no distress for days and weeks, the men often actually gaining in health, seldom losing. If the circumstances be cheerful, such competition, overcoming the forces of nature, is salutary. If peril, strained attention or tyrannous officers complicate the conditions, ill health may appear early and is then often severe.

When to sleep is again a matter of opinion. Early rising is by common consent a salutary custom, especially when the day comes early, not otherwise. It is agreed that more sleep is required in winter than in summer. The best sleep is had during the hours of darkness. The mind is clearest in the early morning, and those who can utilize this period for intellectual work are capable of turning out the best products. Some can not do so, or think they can not, and yet furnish excellent results.

The sleeping room should be cool, abundant air being always admitted. This should not be interpreted to mean that the room may safely remain intensely cold. In the modern treatment of tuberculosis fresh air is recognized to be imperatively needed all day and all night. Artificial heat can, and should, be supplied along with the fresh air, till the temperature of the room be at or near 50° F. or 55° F., for some even 60° F. Above this no one in health is likely to sleep in perfect comfort. Babies and invalids need a heat of from 60° F. to 70° F., even more at times, yet all require the fresh air, or fullest ventilation.

Fever patients, even those suffering from pneumonia or bronchitis, may sleep with safety and great advantage in a thoroughly ventilated cool room and with no more covering on them than is needed for protection from sudden changes of temperature which might send their body heat down below normal. It is needless to particularize as to the offensiveness, deleteriousness, of the body and lung exhalations emitted by those asleep. This is more than apparent, it is actually greater by far than when awake, and demands prompt removal and an abundance of good air to replace that which is vitiated. There are those who still cling to the shred of demon influence which causes them to 'dread the night air' when spirits range and goblins weave evil spells; when diseases come wafting in at open windows, keyholes

and other joints in the harness of defense. Since the pestiferous mosquito has been proved the chief carrier of mephitic paludal diseases, insect nettings are deemed sufficient to ward off evil nocturnal influences. Sleeping in a close exhausted atmosphere is so promptly and painfully punished by discomforts, that it would seem there could not be two minds on the matter. Yet many refined and educated folk still prefer the shut windows. Curiously enough some woodsmen, farmers and others who live much in the open air incline to a hot room for sleeping. To my sorrow, I have often been compelled to experience this prejudice.

Body clothing at night should be loose, not dense, permitting the ready passage of air, never of wool next to the skin. Bed clothing should not be too close of texture, blankets being preferable to dense 'comfortables' and not 'tucked in' too closely. Air should be allowed to pass occasionally under the sides at least as one turns about more or less freely. I have proved this in open camps in bitter temperatures, thus using less clothing than those who slept in bags. Indian guides often sleep with their heads covered and their feet bare to the fire. Even on the long trail I prefer pajamas to close fitting day underwear at night. Under these circumstances, too, occasionally rising and warming by a fire gives better rest than to stay close in a sleeping bag all night long. As to beds the firm mattress with springs is vastly better than soft clinging surfaces.

Some people sleep with a profundity, a completeness, from which they can only be aroused with difficulty. They occasionally wake unrefreshed with confusion, headaches, stiffness and soreness of limbs. This is unfortunate and usually betokens some abnormality in health which should be corrected. Such deep somnolence is not so restorative as the lighter forms of slumber. Again limbs become cramped, hence nerves and blood vessels suffer hurtful pressure, by long remaining in one position; the integrity of the internal organs likewise is imperilled. Sleep is invited by darkness. Light, even though the eyes be closed, penetrates the lids and stirs the consciousness through these most delicate of sense organs. Hence it is wise to exclude light if one must sleep after the sun has risen. A useful device is to cover the eyes with black cloth or even a handkerchief folded, or use a screen, rather than to exclude daylight from the entire room, which too often means exclusion of air as well. Those whose heart and arteries lack tone may give attention to this to secure or to maintain sleep. Day drowsiness and night wakefulness indicate often a cardiac weakness demanding attention. Conversely, high pulse is usually present in those who sleep over heavily.

A complete circulatory balance is needed for those who would sleep most refreshingly. One of the best means to secure this is by exercise

at bedtime, enough to distribute the blood to the surface and muscles, hence to relieve the tension in the vessels of the brain. High vascular tension is often a cause of insomnia; it may be continuous or only due to psychic causes, worries, morbid tension, over-excited circulation or toxins. Hence the common device of the hot foot bath, hot entire bath, or even a cold bath inducing reaction, may suffice. To execute some systematic movements with little or no clothing on is better; in cold weather with extra clothing on, such as a sweater. Certain movements, especially those of the neck and shoulders, are particularly useful. A series of movements I devised in treating a chronic neurosis put many patients promptly to sleep. Also certain manipulations of the neck, especially a distributed pressure over the posterior occipital nerves, have in certain cases of obstinate insomnia in my hands been followed by complete cure. One man who claimed he had not slept a full night for thirty years was thus put to sleep in my office and after a course of treatment he remained free from this distress. That admirable instrument, now unfortunately out of fashion, the bicycle, cured scores of insomniacs by affording patients the means of prompt lowering of blood pressure by a ride just before bedtime. Few measures are more prompt, certain and permanent.

Eating some light food is often of value, but the overfull stomach is frequently a cause of shallow or distressed sleep. There are many forms of digestive derangement, liver troubles, toxemias, etc., which impair sleep in those who are under the impression they have powerful digestions. Nothing wakes some people so certainly at evil hours as an over-acid stomach, relievable by a simple alkali or charcoal. The bowels are best evacuated before bedtime; if full they may cause much loss of sleep. In short, as Emerson says of all health, of which sleep is a major item, it is not to be bought, it must be *earned;* and wisdom, frugality, self restraint, industry, perhaps all cardinal virtues, contribute to this boon.

STATE UNIVERSITY SALARIES.

By C. W. FOULK and R. F. EARHART.

FROM time to time the question of the relatively low pay of members of the teaching profession is brought to the foreground in the public press. The statements made are as a rule only general in character, or if any actual figures are given for a large group of teachers they usually relate to those in the public schools. It has happened, however, that during the last half year certain comments have been made on the remuneration of college and university professors. Sir William Ramsay, the eminent English chemist, remarked during a recent visit to this country on the absence here of any great academic prizes, positions of high standing and large salary together with leisure for carrying on research. An article in the New York *Evening Post* of recent date has also been widely quoted. This purports to give a brief account of the salaries paid at Harvard. From it one learns that, roughly speaking, the average salary of a professor there is $4,000, of an associate professor $3,000, of an assistant professor $2,000, of an instructor $1,000, while an assistant must content himself with from $250 to $400. The *Post* intimates that the situation at Harvard is better than at any other American university. Whatever may be the real state of affairs, these figures may certainly be looked upon as being among the highest. Indeed, to anticipate one of the chief items in the statistical part of this paper, it may be said that the average salary of the professors in the state universities of the middle west is $2,315. This, whether it be too low or not, is certainly lower than $4,000.

The question at Harvard is receiving its full share of attention, for it has been noted in a recent number of *Science* that $1,800,000 of a fund of $2,500,000 has been raised to be devoted 'to increase the present totally inadequate amount available for the salaries of the teaching staff.' The Carnegie pension fund is another item of interest in the matter. In THE POPULAR SCIENCE MONTHLY of December, 1904, an article under the title 'Status of the American College Professor' has much to say of the financial side, and in the *Atlantic Monthly* for May of this year an anonymous writer discusses in detail the necessary expenses of a college professor. These exceedingly pithy articles will be found to have an added interest in the light of the statistics brought out in this paper.

But if this question of university salaries is to be discussed at all

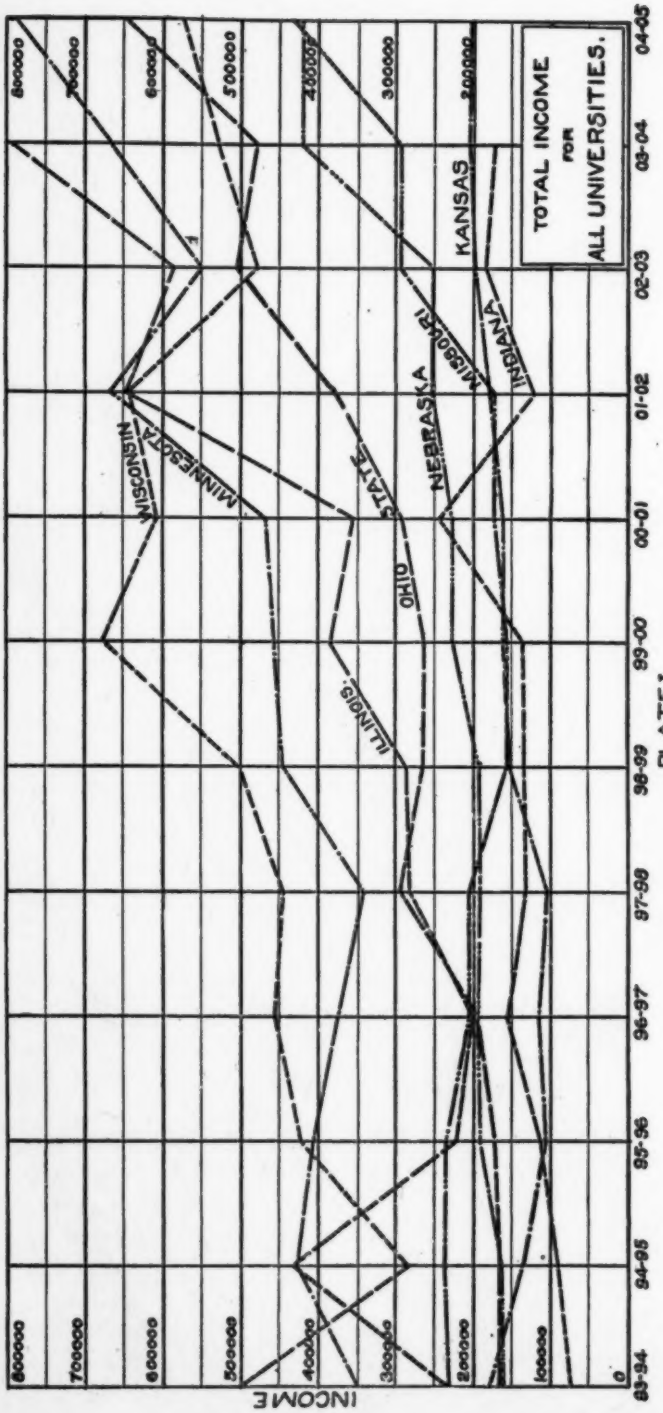


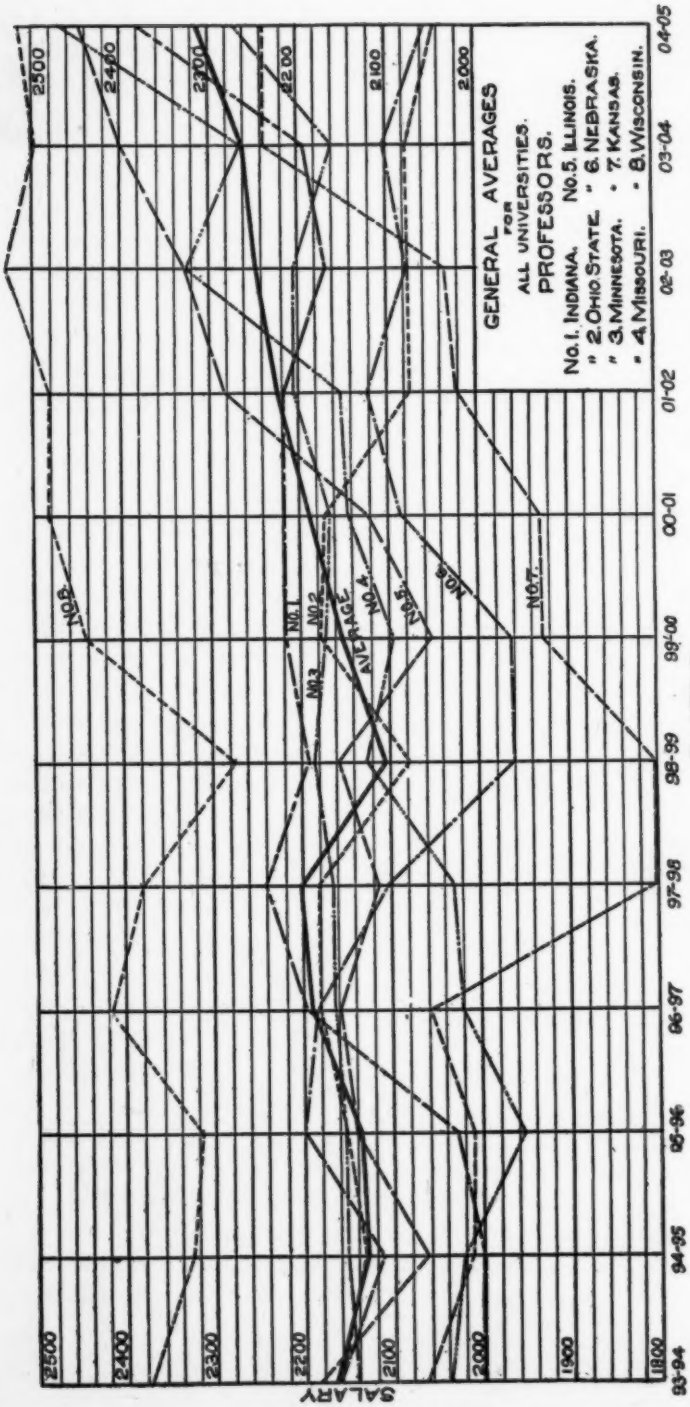
PLATE I. Incomes year by year from 1893–4 to 1904–5.

intelligently, the starting point must be comprehensive statistics showing exactly what the situation is. To get such statistics is not an easy task. Though most institutions of learning have published reports giving details of their business management, these reports are not always easy to find, and, when found, certain kinds of information are not always easy to obtain from their pages. In taking up the matter, the authors saw that with the time at their disposal only a limited number of institutions could be studied. In selecting this small number, it seemed desirable to take a representative group of some well defined type so that the figures would have wider application. In choosing the type the state university of the Middle West was selected, for the reason that in this large section of the country it is the most important type, not in numbers, for in this particular the small denominational college outranks it thirty to one, but in wealth, number of students and rapid rate of growth.

The actual group of which a discussion is to be found in the following pages consists of the universities of Wisconsin, Minnesota, Nebraska, Kansas, Missouri, Illinois, Indiana and Ohio. Effort was also made to secure similar data from the universities of Iowa and Michigan, but without success.

These eight universities may certainly be looked upon as representative. They have shared in the development of the region in which they lie. The equipment, the attendance and the number of instructors have increased to a remarkable extent, and, finally, there is in them an almost entire absence of traditions of the past. In such institutions, if anywhere, one would expect to find the normal salary and the normal rate of change of salary. That is, the increase in the incomes of these schools, as well as other conditions of a secondary influence, has been such that a greater or less increase in the salaries paid has been largely a matter of policy, to be followed or not as their various boards of trustees have seen fit; and it is therefore reasonable to suppose that whatever state of affairs in regard to salaries exists in these institutions more nearly represents the rating of the positions on the part of the people than can be found in other universities and colleges.

In the following pages then will be found an account of the salaries paid at these eight institutions. No discussion of the conditions prevailing at the several schools will in any sense be attempted. The data as obtained from the published, or soon to be published, reports are given and the important items are pointed out by references in the text. Whatever local conditions may exist for explaining this or that peculiarity are beyond the scope of the paper, which aims solely at a presentation of the facts in this group of representative institutions, the authors believing that such a presentation should be preliminary to any change that may come.


GENERAL AVERAGES
FOR
ALL UNIVERSITIES.
PROFESSORS.
No. 1. INDIANA. No. 5. ILLINOIS.
" 2. OHIO STATE. " 6. NEBRASKA.
" 3. MINNESOTA. " 7. KANSAS.
" 4. MISSOURI. " 8. WISCONSIN.
AVERAGE
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
No. 7
No. 8
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03-04
04-05

PLATE II

A graphical scheme has been chosen as this presents at a glance the general situation from year to year. A large amount of data was, however, collected that will not admit of simple graphical treatment; for instance, the maximum and minimum salaries, the number of men of a given rank from year to year, the number receiving a given salary, etc. To have presented all this would have multiplied unduly the number of plates, and therefore no such presentation will be attempted.

Most of these figures, as was mentioned above, were obtained from the published reports of the institutions. Those for the last two years, however, were kindly furnished by the executive departments of the universities.* In addition, all the data for each university were referred back for correction, if necessary, and therefore may be looked upon as official. Only data relating to the salaries of professors, associate professors and assistant professors are given, for the reason that to have included the large number of instructors, assistants, etc., would have demanded too much time.

This shows the total income of each university during the past twelve years, that for the current year being, of course, estimated. At present Minnesota heads the list with an income of approximately $800,000. Ohio, Wisconsin, Missouri, Nebraska and Kansas follow in the order named, with Indiana and Illlinois not given.

In connection with this it ought to be said that both Kansas and Indiana support two institutions of higher learning; each state having in addition to the university an agricultural and mechanical college. In the other states these subjects are not given in separate schools, but make a part of the university curriculum. In this paper only those institutions officially designated as state universities are considered. This of course will greatly affect the relative income, but should in no sense affect the salaries.

This shows the average salary from year to year paid at each of the universities to men holding the rank of professor. The heavy line on this plate marked 'average' gives the average salary of professors in the eight institutions. It was obtained by treating the eight universities as one and dividing the total amount paid each year to professors by the number of men of this rank in the eight schools.

Two notes of explanation are required in regard to this plate: (1) Many men in the professional schools of law and medicine hold the rank of professor, but inasmuch as they give only a small part of their time to teaching they receive relatively low salaries. Obviously they represent professions other than that of teacher, and all such are

* The authors wish in this place to thank the presidents of these eight universities for their ready aid, which made possible the collection of the data for the more recent years. They feel especially indebted to Dr. W. O. Thompson, of Ohio, through whose kind assistance the interest of the others was enlisted.

accordingly omitted. (2) In some places the deans of the several colleges in the university receive extra compensation owing to the executive work required of them. They have, however, been included in the averages because their work is entirely within the university and educational in character. This paper aims solely at a discussion of the pecuniary side of the positions in these state universities, aside from that of president, and therefore it seemed fitting to rate the deans with the professors, rather than to make a separate list.

The noticeable features in the average salary curve are the high points at the years 1896–7 and 1897–8, the sudden drop at 1898–9 and the steady upward trend from that time to the present. An inspection of the tabulated data from which the curves were compiled shows that during the year 1895–6 there were in the eight universities 187 professors at an average salary of $2,139. In 1896–7 the number increased to 196, but increases in salary raised the average to $2,193. During the next year, 1897–8, the number rose to 202, while the average salary reached $2,202. In the next year, 1898–9, however, something seemed to happen. There appears to be evidence that in some institutions, at any rate, salaries were actually cut. The number of professors reached 224. The average salary fell in four universities, remained constant at a very low mark in one and rose in three. This was the low water mark, for from that lean year to the present there has been a steady increase, the curve being almost a straight line. Great differences are, however, to be noted during this period in the several universities. In four of them, Wisconsin, Illinois, Kansas and Missouri, the rate of increase in the average salary is more rapid than that of the general average for the eight. In two of them, Indiana and Minnesota, there is an increase, but at a less rapid rate than the average for all. One of them, Nebraska, increased rapidly during the first three years and then suddenly declined. One of them, Ohio, shows a decline since 1899–1900. Advance reports of the Ohio salary list for 1905–6 show an upward trend, the averages for that year being as follows: professors, $2,200; associate professors, $1,580; and assistant professors, $1,347. In 1898–9 the average salary was $2,106. At present, 1904–5, it is $2,315.

This period of seven years, beginning with 1898–9 and ending with the present academic year, is peculiarly suited to a study of the salary question. During this period, times in general have been good and the universities themselves have prospered, as an inspection of Plate I. will show. The time embraced is sufficiently long to warrant general conclusions, and it is therefore reasonable to suppose that whatever changes may have taken place may be looked upon as more nearly normal than in the preceding period.

It is gratifying to note that the average salary has increased in a substantial manner, it being now practically ten per cent. more

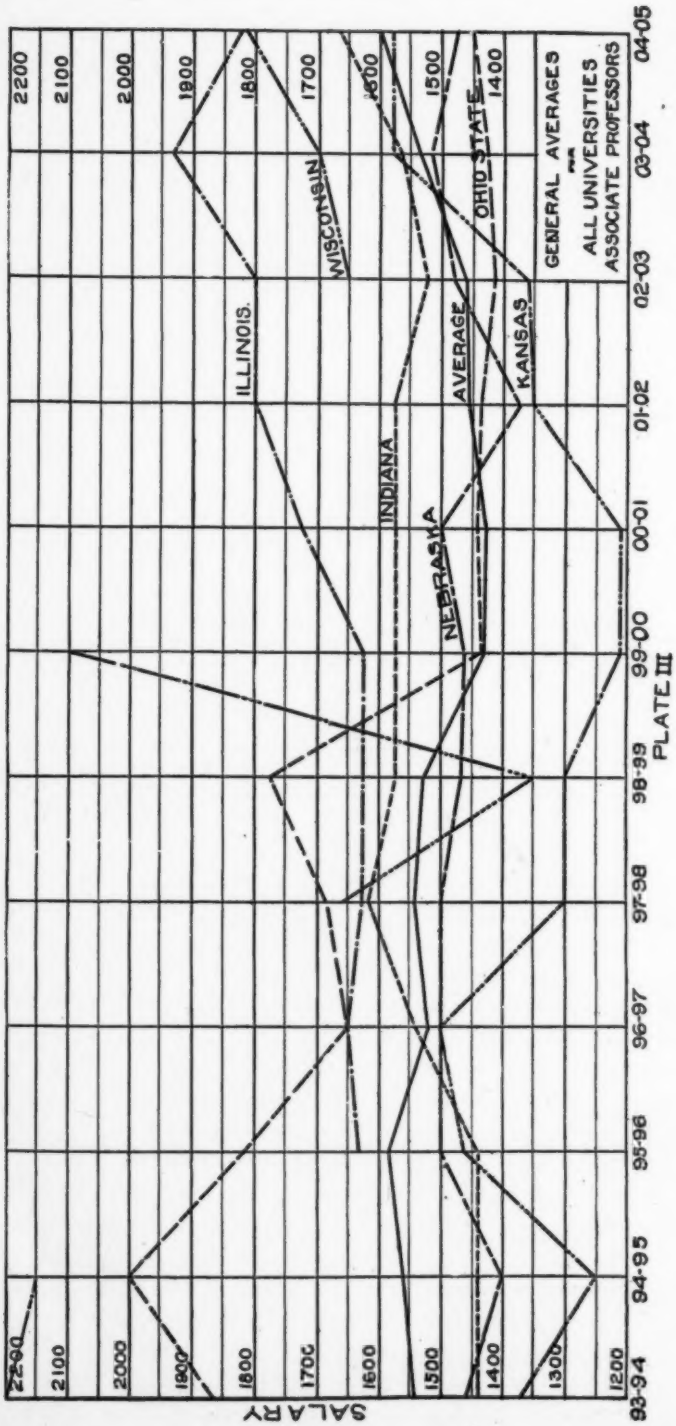
than in 1898–9. The increased cost of living, however, during this time should be taken into consideration before a final conclusion is reached in regard to the real state of affairs.

Before leaving the discussion of this the most important of the plates, the reader should be warned against ascribing too great significance to the ordinary ups and downs of the curves. In the first place, the arithmetical mean leaves much to be desired as a single expression for giving an idea of a set of numbers that differ much among themselves. Secondly a rather slight change in number and salaries of the professorial staff of an institution will in some cases change the average out of proportion to the actual change. The scheme of giving the averages is, however, the best that can be used, and when the trend of the curves for a period of years is taken into consideration, it is believed that they very fairly represent the situation.

Naturally an inspection of the complete data from which the curves were plotted reveals many interesting and important points which the curves themselves fail to show. For instance, one interesting feature that presents itself is that in the majority of the institutions there appears to be a 'normal' salary for men of full professorial rank; that is, a sum which all professors receive unless there be a special reason for their getting more or less. This is inferred from the following figures taken from the data for 1904–5, but typical of the whole period: In Kansas 57 per cent. of the professors are receiving $2,200 each; in Nebraska 47 per cent. receive $2,100; in Minnesota 48 per cent. receive $2,400; Indiana pays 53 per cent. $2,500; and in Ohio 40 per cent. get $2,250. (In 1905–6, 36 per cent. will receive $2,500.) In Wisconsin 33 per cent. receive $2,500 and 20 per cent. $2,000. Wisconsin has apparently two 'normal' salaries, a condition not presented by any of the others. In the cases of Missouri and Illinois no considerable proportion of the faculty receive the same salary. These so-called 'normal' salaries do not coincide with the average salary, they being sometimes higher and sometimes lower and differing in maximum by over $200 from the average.

In regard to high salaries, Wisconsin heads the list. In this institution, in 1904–5, ten deans and professors are receiving from $3,000 to $4,500. The lowest recorded salary, $1,000, is also on Wisconsin's list. Illinois and Missouri are the only other universities of the eight that pay a professor more than $3,000. All of them are paying some men $2,500 and in four of them this is the highest salary paid. All but one, Indiana, pay some of their professors less than $2,000. It should be borne in mind that these figures refer to salaries of men of full professorial rank and do not include associate and assistant professors.

Taking the period beginning with 1898–9 and closing with the present academic year, 1904–5, it is seen from the complete data that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04-05
ILLINOIS
WISCONSIN
INDIANA
NEBRASKA
AVERAGE
OHIO STATE
KANSAS
GENERAL AVERAGES
ALL UNIVERSITIES
ASSOCIATE PROFESSORS

PLATE III

in these eight universities the number of professors receiving $2,500 or more has increased from 40 out of a total of 224, or about 18 per cent., to 89 out of a total of 285, or 31 per cent. On the other hand, the number receiving less than $2,000 has decreased from 21 per cent. in 1898–9 to less than 12 per cent. at present.

Among the several universities there are very great differences. At present Wisconsin pays 60 per cent. of her professors $2,500 or more; Indiana, 53 per cent.; Missouri, 44 per cent.; Illinois, 43 per cent.; Nebraska, 16 per cent.; Kansas, 10 per cent.; and Ohio 5 per cent. In 1905–6, Ohio will pay 36 per cent., $2,500. As to the number receiving less than $2,000, the percentage ranges from 0 in Indiana to 31 in Ohio.

Here is shown in a manner similar to that for professors the averages for associate professors.

This title does not exist in the University of Missouri, and at Wisconsin there have been periods—indicated by the omitted parts of the curve—when no one held it. The University of Minnesota, in sending data, classed associate professors and professors together.

The interesting feature brought out by an inspection of the data is the relatively small number of men holding this title. It has, however, increased with fair uniformity from 18 in 1893–4 to 49 in 1904–5. Among the several institutions there are great differences, Ohio and Kansas being in the lead. The figures for 1903–4 represent very well the relative numbers during the last five or six years and are accordingly given. In that year Wisconsin had 1; Minnesota, 0; Nebraska, 6; Illinois, 3; Indiana, 9; Missouri, 0; Kansas, 14; and Ohio, 19 associate professors.

In a general way the average salary curve for men of this title follows the trend of the curve for professors. At present it is $1,600.

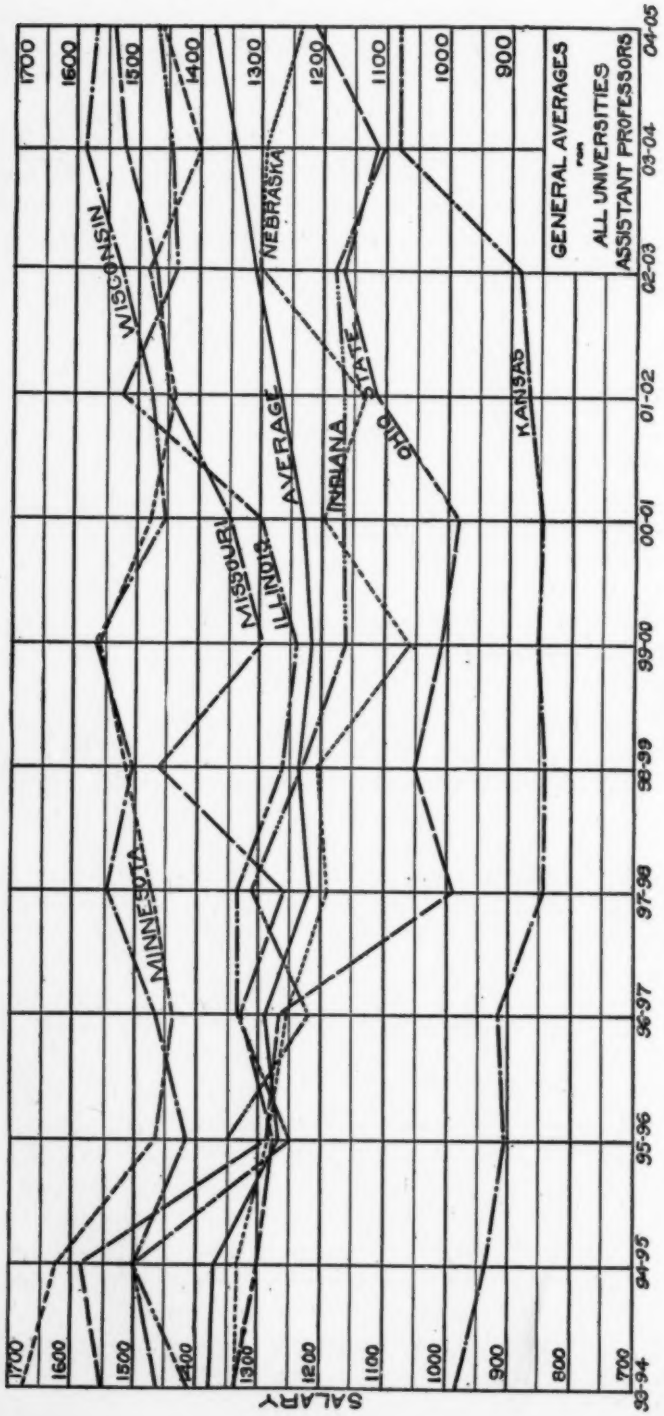
This gives the averages for assistant professors. These have increased steadily in number from 61 in 1893–4 to 159 in 1904–5. The general average curve shows the same trend as the preceding ones, the average salary being now $1,374.

Previous to 1901 the title of assistant professor did not exist in the University of Nebraska, the lowest professorial grade being adjunct professor. Since 1901, however, assistant professors have been added, thus making four grades with the title of professor.

Inasmuch, however, as the adjunct professors represented the third grade of professorial rank which in position at least corresponds to assistant professor in the other institution, they were rated as such on Plate IV. until 1900–1, the advent of the assistant professor.

The Nebraska curve then is really that of the adjunct professors till 1900–01, after which it refers to the assistant professors.

Having now obtained the exact data in regard to salaries, the question may arise as to whether the professorial position does not carry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GENERAL AVERAGES
—
ALL UNIVERSITIES
ASSISTANT PROFESSORS
WISCONSIN
MINNESOTA
MISSOURI
ILLINOIS
AVERAGE
NEBRASKA
INDIANA
STATE
OHIO
KANSAS

PLATE IV.

with it, in many cases at least, certain perquisites in the way of rooms, board, etc., in the university buildings; and if in an indirect way opportunities are not offered for large fees for expert consultation work, etc., thus very materially raising the real income.

In regard to the first of these items relating to house and board, it may be said to be entirely negligible. In some of these eight institutions the president receives his house in addition to his salary, but no professor is thus favored. A discussion of the second item, sources of income attracted by the position, is impossible because of lack of data. Some few professors do receive at times large fees for expert work. Others, to eke out a meager salary, do a certain amount of routine work. Still others receive something in the way of royalties on their books. An estimate of the general average addition to the income through these sources would, however, be nothing but a guess and will therefore not be attempted. It should be said, though, in regard to all such work, that it is done in addition to the regular duties and is to be looked upon as that much extra labor accomplished ofttimes by taking time from much needed vacation periods.

Looking back over the above figures, it is seen that the average pecuniary attraction in the field of state university work is $2,315 per year plus an indefinite amount that may be made by extra work. It is further seen that this sum is increasing, but at such a slow rate as to leave it an open question as to whether the increase is keeping pace with the increased cost of living. In comparison with the salaries or incomes of men of like training, age and experience in other professional lines such as law, medicine, engineering, etc., it is small, being perhaps not more than one third or one fourth as much. Some of this great difference might be accounted for by the fact that the university man enjoys longer vacations; but, assuming that no work at all is done during the time the university is not in session, and that the vacation time includes one fourth of the year, the salary of the professor would still be small in comparison with that of other professional men. In making these comparisons, it will possibly be objected by some that the average of the whole number of professors is compared with the incomes of the more successful men in other lines. To this it may be said that the salaries of all professors are not so compared. These eight universities are all large and rich institutions. Were one to collect statistics of the 150 to 200 small colleges in this region where the salaries are far lower than in the state universities, the general average professorial salary would undoubtedly drop to less than $1,800. It must be borne in mind then that it is entirely fair to compare the salary of the state university man with that of the more successful men in other lines.

In very intimate relation with the income to be expected is the cost of preparation. It is doubtful if in any other line so much is spent in preparing for the work. After completing the four years undergraduate course the aspirant for professorial honors must spend at least two or three years in graduate work in some large university. On completing this he will be fortunate if he obtains even an assistant professorship. More usually he becomes an assistant or instructor at $600 to $700 a year.

The manner of living required in any position is also closely related to income received. Here, too, the professor has nothing to his advantage, for he is compelled to keep up appearances. He must dress well, and his house must be in a good neighborhood. In order to meet other men in his line he must attend the meetings of technical societies, where these men come together. Finally he is supposed to be a patron of the arts and sciences and the owner of a fine library, all of which costs money.

The sentimental side of the question, the compensations coming from love of the work, seeking for truth, pursuit of ideals, in short, the things that are worth more than money, the authors will not discuss, feeling that it would be without the scope of the paper. They do not wish to be understood, however, as taking so sordid a view as to place money compensation above everything else. Still, the subject can not be left without this reflection: other professions also have their ideals. Because the lawyer or surgeon or engineer receives more salary, it scarcely follows that he has no ideals, does not love his work and takes no thought of service to his fellow men. Can it be shown that these are not worth as much as the ideals of the teacher? If it can not, it follows that the teacher pays too high a price for the privilege of following his chosen work.

Finally, one other question will be raised. Does not the low salary exert an influence on the kind of men who go into the profession of university teaching? It is sometimes flatly stated that the best men do not enter the profession because of this fact. This point, also, the authors, who are just entering the professorial ranks themselves, obviously do not want to discuss, hoping that in presenting the facts of the situation they have contributed their share and made the way easier for wiser minds to follow.

NATURE AND MAN.*

By EDWIN RAY LANKESTER, M.A., Hon. D.Sc., F.R.S.,

HON. FELLOW OF EXETER COLLEGE, DIRECTOR OF THE NATURAL HISTORY DEPARTMENTS OF THE BRITISH MUSEUM, LATE LINACRE PROFESSOR IN THE UNIVERSITY OF OXFORD.

IT is the pride of our ancient universities that they are largely, if not exclusively, frequented by young men of the class who are going to take an active part in the public affairs of the country—either as politicians and statesmen, as governors of remote colonies, or as leaders of the great professions of the church, the law and medicine. It would seem, then, that if these universities attached a greater, even a predominant, importance to the studies which lead to the knowledge and control of nature, the schools would follow their example, and that the governing class of the country would become acquainted with the urgent need for more knowledge of the kind, and for the immediate application in public affairs of that knowledge which exists.

It would seem that in Great Britain, at any rate, it would not be necessary, were the universities alive to the situation, to await the pressure of democracy, but that a better and more rapid mode of development would obtain; the influential and trusted leaders of the community would set the example in seeking and using for the good of the state the new knowledge of nature. The world has seen with admiration and astonishment the entire people of Japan follow the example of its governing class in the almost sudden adoption of the knowledge and control of nature as the purpose of national education and the guide of state administration. It is possible that in a less rapid and startling manner our old universities may, at no distant date, influence the intellectual life of the more fortunate of our fellow citizens, and consequently of the entire community. The weariness which is so largely expressed at the present day in regard to human effort—whether it be in the field of politics, of literature, or of other art, or in relation to the improvement of social organization and the individual life—is possibly due to the fact that we have exhausted the old sources of inspiration, and have not yet learnt to believe in the new. The 'return to nature,' which is sometimes vaguely put forward as a cure for the all-pervading 'taedium' of this age, is perhaps an imperfect expression of the truth that it is time for civilized man not to return to the 'state of nature,' but to abandon his retrospective

* Concluding part of the Romanes Lecture, delivered in the Sheldonian Theatre, Oxford, on June 14, 1905.

attitude and to take up whole-heartedly the kingdom of nature which it is his destiny to rule. New hope, new life will, when he does this, be infused into every line of human activity: art will acquire a new impulse, and politics become real and interesting. To a community which believes in the destiny of man as the controller of nature, and has consciously entered upon its fulfillment, there can be none of the weariness and even despair which comes from an exclusive worship of the past. There can only be encouragement in every victory gained, hope and the realization of hope. Even in the face of the overwhelming opposition and incredulity which now unhappily have the upper hand, the believer in the predestined triumph of man over nature can exert himself to place a contribution, however small, in the great edifice of nature-knowledge, happy in the conviction that his life has been worth living, has counted to the good in the imperishable result.

If I venture now to consider more specifically the influence exercised by the University of Oxford upon the welfare of the state and of the human community in general, in view of the conclusions which have been set forth in what has preceded, I beg to say that I do so with the greatest respect to the opinions of others who differ from me. When I say this I am not using an empty formula. I mean that I believe that there must be many here present who are fair-minded and disinterested, and have given special attention to the matter of which I wish to speak, and who are yet very far from agreeing with me. I ask them to consider what I have said, and what I have further to say, in the same spirit as that in which I approach them.

It seems to me—and when I speak of myself I would point out that I am presenting the opinions of a large number of educated men, and that it will be better for me to avoid an egotistical attitude—it seems to us (I prefer to say) that the University of Oxford by its present action in regard to the choice and direction of subjects of study is exercising an injurious influence upon the education of the country, and especially upon the education of those who will hereafter occupy positions of influence, and will largely determine both the action of the state and the education and opinions of those who will in turn succeed them. The question has been recently raised as to whether the acquirement of a certain elementary knowledge of the Greek language should be required of all those who desire to pursue their studies in this university, and accordingly whether the teaching of the elements of this language should form a prominent feature in the great schools of this country. It seems to us that this is only part of a much larger question; namely, whether it is desirable to continue to make the study of two dead languages—and of the story of the deeds of great men in the past—the main if not the exclusive matter to which the minds of the youth of the well-to-do class are directed by our schools and universities. We have come to the conclusion that this form of educa-

tion is a mistaken and injurious one. We desire to make the chief subject of education both in school and in college a knowledge of nature as set forth in the sciences which are spoken of as physics, chemistry, geology and biology. We think that all education should consist in the first place of this kind of knowledge, on account of its commanding importance both to the individual and to the community. We think that every man of even a moderate amount of education should have acquired a sufficient knowledge of these subjects to enable him at any rate to appreciate their value, and to take an interest in their progress and application to human life. And we think further that the ablest youth of the country should be encouraged to proceed to the extreme limit of present knowledge in one or other branch of this knowledge of nature so as to become makers of new knowledge, and the possible discoverers of enduring improvements in man's control of nature. No one should be educated so as to be ignorant of the importance of these things; and it should not be possible for the greatest talent and mental power to be diverted to other fields of activity through the fact that the necessary education and opportunity in the pursuit of the knowledge of nature are withheld. The strongest inducements in the way of reward and consideration ought, we believe, to be placed before a young man in the direction of nature-knowledge rather than in the direction of other and far less important subjects of study.

In fact, we should wish to see the classical and historical scheme of education entirely abandoned, and its place taken by a scheme of education in the knowledge of nature.

At the same time let me hasten to say that few, if any of us—and certainly not he who now addresses you—would wish to remove the acquirement of the use of languages, the training in the knowledge and perception of beauty in literary art, and the feeding of the mind with the great stories of the past, from a high and necessary position in every grade of education.

It is a sad and apparently inevitable accompaniment of all discussion of this matter that those who advocate a great and leading position for the knowledge of nature in education are accused of desiring to abolish all study of literature, history and philosophy. This is, in reality, so far from being the case that we should most of us wish to see a serviceable knowledge of foreign languages, and a real acquaintance with the beauties of English and other literature, substituted for the present unsuccessful efforts to teach effectively either the language or literature of the Greeks and Romans.

It should not be for one moment supposed that those who attach the vast importance which we do to the knowledge of nature imagine that man's spirit can be satisfied by exclusive occupation with that knowledge. We know, as well as any, that man does not live by bread

alone. Though the study of nature is fitted to develop great mental qualities—perseverance, honesty, judgment and initiative—we do not suppose that it completes man's mental equipment. Though the knowledge of nature calls upon, excites and gratifies the imagination to a degree and in a way which is peculiar to itself, we do not suppose that it furnishes the opportunity for all forms of mental activity. The great joys of art, the delights and entertainment to be derived from the romance and history of human character, are not parts of it. They must never be neglected. But are we not justified in asserting that, for some two hundred years or more, these 'entertainments' have been pursued in the name of the highest education and study to the exclusion of the far weightier and more necessary knowledge of nature? 'This should ye have done, and yet not left the other undone,' may justly be said to those who have conducted the education of our higher schools and universities along the pleasant lines of literature and history, to the neglect of the urgently-needed 'improvement of natural knowledge.' Nero was probably a musician of taste and training, and it was artistic and high-class music which he played while Rome was burning: so too the studies of the past carried on at Oxford have been charming and full of beauty, whilst England has lain, and lies, in mortal peril for lack of knowledge of nature.

It seems to be beyond dispute that the study, firstly of Latin, and much more recently of Greek, was followed in this university and in grammar schools, not as educational exercises in the use of language, but as keys to unlock the store-rooms—the books—in which the knowledge of the ancients was contained. So long as these keys were needed, it was reasonable enough that every well-educated man should spend such time as was necessary in providing himself with the key. But now that the store-rooms are empty—now that their contents have been appropriated and scattered far and wide—in all languages of civilization, it seems to be merely an unreasoning continuation of superannuated custom to go on with the provision of these keys. Such, however, is the force of habit that it continues: new and ingenious reasons for the practise are put forward, whilst its original object is entirely forgotten.

In the first place, it has come to be regarded as a mark of good breeding, and thus an end in itself, for a man to have some first-hand acquaintance with Latin and Greek authors, even when he knows no other literature. It is a fashion, like the wearing of a court dress. This can not be held to justify the employment of most of the time and energy of youth in its acquirement.

A second reason which is now put forward for the practise is that the effort and labor expended on the provision of these keys—even though it is admitted that they are useless—is a wonderful and incomparably fine exercise of the mind, fitting it for all sorts of work. A

theory of education has been enunciated which fits in with this defence of the continued attempt to compel young men to acquire a knowledge, however imperfect, of the Latin and Greek languages. It is held that what is called 'training the mind' is the chief, if not the only proper, aim of education; and it is declared that the continuation of the study of those once useful, but now useless, keys—Latin and Greek—is an all-sufficient training. If this theory were in accordance with the facts, the conclusion in favor of giving a very high place to the study so recommended would be inevitable. But the facts do not support this theory. Clever youths are taken and pressed into the study of Greek and Latin, and we are asked to conclude that their cleverness is due to these studies. On the other hand, we maintain that though the study of grammar may be, when properly carried out, a valuable exercise, yet that it is easily converted into a worthless one, and can never in any case take the place of various other forms of mental training, such as the observation of natural objects, the following out of experimental demonstration of the qualities and relations of natural bodies, and the devising and execution of experiment as the test of hypothesis. Apart from 'training' there is the need for providing the mind with information as well as method. The knowledge of nature is eagerly assimilated by young people, and no training in mental gymnastics can be a substitute for it or an excuse for depriving the young of what is of inestimable value and instinctively desired.

The prominence which is assigned to a familiarity with the details of history, more especially of what may be called biographical history, in the educational system favored by Oxford, seems to depend on the same causes as those which have led to the maintenance of the study of Greek and Latin. To read history is a pleasant occupation which has become a habit and tradition. At one time men believed that history repeats itself, and it was thought to be a proper and useful training for one who would take part in public affairs to store his mind with precedents and picturesque narratives of prominent statesmen and rulers in far-off days and distant lands. As a matter of fact it can not be shown that any statesman, or even the humblest politician, has ever been guided to useful action by such knowledge. History does not repeat itself, and the man who thinks that it does will be led by his fragmentary knowledge of stories of the past into serious blunders. To the fashionable journalist such biographical history furnishes the seasoning for his essays on political questions of the day. But this does not seem to be a sufficient reason for assigning so prominent a place in university studies to this kind of history as is at present the case. The reason, perhaps, of the favor which it receives, is that it is one of the few subjects which a man of purely classical education can pursue without commencing his education in elementary matters afresh.

It would be a serious mistake to suppose that those who would give a complete supremacy to the study of nature, in our educational system, do not value and enjoy biographical history for what it is worth as an entertainment; or further, that they do not set great value upon the scientific study of the history of the struggles of the races and nations of mankind, as a portion of the knowledge of the evolution of man, capable of giving conclusions of great value when it has been further and more thoroughly treated as a department of anthropology. What seems to us undesirable is, that mere stories and bald records of certain peoples should be put forward as matter with which the minds of children and young men are to be occupied, to the exclusion of the all-important matters comprised in the knowledge of nature.

There are, it is well known, not a few who regard the present institution of Latin and Greek and so-called history, in the preeminent place which they occupy in Oxford and the great schools of the country, as something of so ancient and fundamental a character that to question the wisdom of that institution seems an odious proceeding, partaking of the nature of blasphemy. This state of mind takes its origin in a common error, due to the fact that a straightforward account of the studies pursued in the university during the last five hundred years has never been written. Our present curriculum is a mere mushroom growth of the last century, and has no claim whatever to veneration. Greek was studied by but a dozen or two specialists in Oxford two hundred and fifty years ago. In those days, in proportion to what had been ascertained in that subject and could be taught, there was a great and general interest in the university in the knowledge of nature, such as we should gladly see revived at the present day. As a matter of fact, it is only within the last hundred years that the dogma of compulsory Greek, and the value of what is now called a classical education, has been promulgated. These things are not historically of ancient date; they are not essentials of Oxford. We are therefore well within our right in questioning the wisdom of their continuance in so favored a position, and we are warranted in expressing the hope that those who can change the policy of the university and colleges in this matter will, at no distant day, do so.

It is sometimes urged that Oxford should contentedly resign herself to the overwhelming predominance given to the study of ancient elegance and historic wisdom within her walls. It is said that she may well be reserved for these delightful pursuits, whilst newer institutions should do the hard work of aiding man in his conquest of nature. At first sight such a proposal has a tempting character: we are charmed with the suggestion that our beautiful Oxford should be enclosed by a ring fence and cut off for ever from the contamination of the world. But a few moments' reflection must convince most of us that such a treatment of Oxford is an insult to her and an impossibility. Oxford

is not dead. Only a few decades have passed—a mere fraction of her lifetime—since she was free from the oppression of grammar-school studies, and sent forth Robert Boyle and Christopher Wren to establish the new philosophy of the invisible college in London. She seems, to some of us, to have been used not quite wisely, perhaps not quite fairly, in the brief period which has elapsed since that time. Why should she not shake herself free again, and give, hereafter, most, if not the whole, of her wealth and strength to the urgent work which is actually pursued in every other university of the world as a chief aim and duty?

The fact that Oxford attracts the youth of the country to her, and so determines the education offered in the great schools, is a sufficient answer to those who wish to perpetuate the present employment of her resources in the subvention and encouragement of comparatively unimportant, though fascinating (even too fascinating), studies, to the neglect of the pressing necessary knowledge of nature. Those who enjoy great influence in the affairs of the university tell us with pride that Oxford not only determines what our best schools shall teach, but has, as a main preoccupation, the education of statesmen, pro-consuls, leaders of the learned professions, and members of parliament! Undoubtedly this claim is well-founded, and its truth is the reason why we can not be content with the maintenance by the university of the compulsory study of Greek and Latin, and the neglect to make the study of nature an integral and predominant part of every man's education.

To return to my original contention—the knowledge and control of nature is man's destiny and his greatest need. To enable future leaders of the community to comprehend this, to perceive what the knowledge and control of nature are, and what are the steps by which they are gained and increased, is the duty of a great university. To neglect this is to retard the approach of well-being and happiness, and to injure humanity.

I beg, finally, for toleration from those who do not share my opinions. I am well aware that they are open to the objection that they partake more of the nature of dreams of the future than of practical proposals. That, perhaps, may be accepted as my excuse for indulging in them on such an occasion as the present. There are, and always have been, dreamers in Oxford, and beautiful dreams they have dreamed—some of the past, and some of the future. The most fascinating dreams are not, unfortunately, always realized; but it is sometimes worth while to tell one's dream, for that may bring it a step nearer to 'coming true.'

GENERAL EDUCATION FOR ENGINEERS.

By Professor CHAS. D. MARX,
STANFORD UNIVERSITY.

THERE has been of late years a large increase in the number of students of engineering in our colleges and universities. An investigation made by Professor Raymond, of the Iowa State University, shows that the attendance in arts and science courses has increased in four years 15 per cent., in engineering courses 102 per cent. This tendency on the part of the young men to take up the study of the more practical lines of work in preference to the so-called more liberalizing studies is viewed with grave concern by some. 'Are we to be merely a nation of shopkeepers and engineers?' has been asked from this platform. While not sharing the fear implied in this question, I must admit that because of the tendency of the young men of the country to take up engineering studies, the proper training of the engineer is a matter of vital importance to the commonwealth. The extent to which engineering enters into some of the most vexing problems of our national and municipal life is perhaps fully realized only by men who have an engineering training. The correct solution of these problems can in many cases be given only by engineers; but these must be men trained on broad lines. The charge is brought not infrequently that the professional structure which we rear on the foundation laid in our public schools is a narrow one, lacking in windows from which to gain the necessary outlook for surveying even one's own field, let alone that of one's neighbor. The charge is well founded, but may with equal justice be brought against students in other lines of work.

The graduate from a high school who takes up engineering studies should be required to broaden his intellectual horizon before beginning his professional work. The difficulty of bringing this about is great, and the introduction of the elective system has certainly not helped matters. The tendency toward early specialization is constantly increasing, and one-sided narrow linguists, historians and scientists are as much a menace to the commonwealth as one-sided engineers. For it must be borne in mind that the work which the engineer is called upon to do is in the world, implies contact with men and things and is in its nature broadening. It is cultural in the best sense of the word, and must, therefore, react on him. This does not hold true to the same extent for the other lines of work mentioned. In a democracy

it is of the highest importance that every man realize that the noble duties of citizenship devolve upon him, that he has responsibilities other than those of merely providing the daily bread for himself and his. We have a community of interests only as long as we have common points of contact; we have the latter only as we have a broad common subsidiary training.

Admitting that the high school course of the embryo engineer should be rounded out with additional work in language, science, history and economics, the question arises where shall this knowledge be acquired?

For the training of our engineers we have, broadly speaking, two types of schools in this country—technical schools pure and simple, such as the Massachusetts Institute of Technology, the Rensselaer Polytechnic Institute and others, and engineering departments either in our colleges of engineering and mechanic arts, or in our universities. I group the last two named, because in both of them some of the general culture studies mentioned as necessary for the broadening of the engineer's training are presented merely from the standpoint of the specialist.

In the schools of the first type there is a recognition of the fact that the general culture courses must be adapted to the needs of the technical student. There is a frank acknowledgment that these broadening studies may be made to serve a useful purpose, even when they are not an end to themselves, and that this does not detract from their value. The fact is recognized by teachers of these subjects in purely technical schools, that because the student is to be a specialist in some line of engineering, he can not at the same time be a specialist in ancient and modern languages, in history, economics and the pure sciences. From the engineer's standpoint, as regards the acquirement of this supplementary general training, there is much to be said in favor of the autonomy of technical schools. This, too, is the view at which the German Society of Engineers has arrived. As in this country, there has been a very large increase in the number of students in the technical courses in Germany. So large has this increase been that for a time at least foreign students in mechanical engineering were barred at Berlin. Existing institutions are still so crowded that the establishment of new technical schools is contemplated. The suggestion was made, that in those places where universities existed and technical schools were needed, the latter might well be incorporated in the university. At a meeting held in Munich in September, 1904, which was attended by representative teachers from the technical schools, the universities, the preparatory schools and by engineers of standing in practise, the following resolution was submitted: "It is not desirable in place of establishing new technical high schools, to add technical facul-

ties to existing universities, because both institutions differ in their character and method of instruction." Those assembled, after laying stress on the fact that members of the engineering profession should be judged by the same educational standards as other educated professional men, adopted the above resolution in substance, but, in deference to the university men, the last clause of the resolution was not emphasized; I think, though, that the correctness of the statement is generally admitted.

In spite of these conclusions we find in this country at least a tendency in the opposite direction. In our strongest state universities and in others built on private foundations, we find either engineering departments or colleges. The union of Harvard University and the Institute of Technology is under consideration. Something can, therefore, undoubtedly be said in favor of this arrangement. Of course, the presence of the 'sublimated tinker' in the university has been deprecated, but not by the leaders of educational thought in America.

It is recognized that the presence of a body of hard working, straight thinking young men in a university, even if they intend to make some practical use of their education, is a good antidote for intellectual snobbishness. On the other hand, it must be conceded that the technical student, too, is benefited by being thrown in contact with men in other lines of work, many of which have no direct practical application. Students become acquainted with one another, learn to appreciate one another's point of view, and mutual respect and goodwill result.

While fully recognizing the benefits which come in a general way to the engineering student from this environment, it must, nevertheless, be asserted that, as our universities in their development follow in the wake of the German universities, they too, like them, become unfitted for doing the general culture work, not only for engineering students, *but for all students.* The tendency toward specialization in subjects and subdivisions of subjects leads to the offering of many undoubtedly valuable courses. But they are courses for the specialist, fitted for his needs, and capable of being understood by but few. The giving of general culture courses is discouraged; and there is some justification, as long as the aim of many so-called students is merely to get hours enough to graduate. The summing up of the results in any given line of work and its presentation, so that the non-specialist may get a general view of the field, are dangerous, because of the 'little learning' thus imparted, which, of course, is 'a dangerous thing.'

Even in poetry: "The learned guardians of these treasures insist that they can not be appreciated unless there has been much preliminary wrestling with a 'critical apparatus' and much delving among 'original sources.'"

If the engineering student is to acquire that general cultural training the lack of which is often made a reproach to him, and if the technical school is to find its full development in the university and not as a separate institution, then the university must make provision for this much needed instruction, unless it can be provided for all students elsewhere. It will and should lead to the giving of courses differing in character and differing in method of presentation from those now offered to the specialist, but they may be none the less both useful and inspiring.

It is necessary for the specialist to know the methods of study of his specialty; it is necessary for the general student to know the results of such study. Therefore, to be both useful and inspiring, such courses must be given by men who are past masters in their line of work.

This will be held by many to be a plea in favor of superficiality, and if getting a general view of another line of work is superficiality, why it is a superficiality of which many specialists might well be guilty. The objectors to this kind of general knowledge lose sight of the fact that no one who is thoroughly grounded in his own line of work is likely to be damaged intellectually by such general information. Conscious of the limitations of his knowledge in his own field after years of study, he is not likely to assume that he has mastered another field as the result of a general lecture course in that subject. The chances are, however, that the effect will be to broaden his views, to enlarge his sympathetic understanding of the work of the specialist and to create an atmosphere of mutual respect and consideration for one another's line of work. In order to give such courses there must be an increase in the teaching force in the various lines of work in our universities. Certainly the work of the specialist, upon which progress in any given field depends, must not be stinted for the sake of the seeker after general knowledge. This is one reason why consolidation of the technical school with the university, if the tendency toward specialization in the latter continues, can not bring about economy in instruction. Justification for such consolidation must be sought elsewhere, as shown above. Not only engineering students, but all students pursuing special studies in a university need general courses, and though it may not be possible for us to become a nation of engineers, it is eminently desirable that all educated persons should have at least some general knowledge of engineering. Surely he can not be held to be truly educated who is ignorant of the conditions which surround him, of the methods by which his daily intellectual and physical needs are met. This training is not for the purpose of making more half-baked experts, prepared to pass snap judgments on matters beyond their ken, but for the purpose of teaching them the importance of solving the problems of manufacture, distribution and transportation correctly. These problems trans-

lated stand for the providing of material and mental food for the masses, the betterment of their conditions of living, for healthy homes, for the pure air, the pure earth, the pure water of the sanitarian, for the intellectual growth which is made possible by freeing man from soul- and mind-killing drudgery. Public service is what engineerng stands for, and perhaps the cultural effect of such work will be admitted. The work is as altruistic as that of the physician, as that of the minister. For the spirit of acquisition, for corporate greed the profession of engineering is not responsible. There has been no fear expressed of our becoming a nation of physicians or even of lawyers. The danger to the commonwealth from a superabundance of lawyers may be greater than that from a superabundance of engineers. There need be no danger from either if the lawyers and engineers are men of the right stamp.

Moral integrity does not necessarily go with cultural training so called. Men with the broadest of cultural training may be found in the pay of corporations striving for illegal franchises. Political bosses with no cultural training may be found abetting them. Engineers may probably be called upon to carry out the work. The danger to the community lies not in the character of the work, but in the character of the man; and a nation is in no danger even if it be largely a nation of engineers, as long as these men are men of character. Such men our engineering schools are trying to train and send out into the world. Some of them as yet may be lacking in general training, but no one feels this shortcoming more keenly than these very men. If others were as conscious of their own shortcomings, of their woful lack of knowledge of the engineering of to-day, it would be well indeed. That these engineers, sent out by our schools, are making their presence felt in the world can not be gainsaid; that they have contributed to the mental and moral uplifting of this nation, no one who thinks deeply will deny.

QUACKERY.*

BY DUDLEY F. SICHER,
YALE UNIVERSITY.

WHAT impresses one in reviewing the literature, is the extent and ancient origin of quackery, and the ineffectual fight against it. Eight pages of the 'Index Catalogue of the Library of the Surgeon-General's Office' are taken up with a bare list of books, pamphlets and addresses, exploiting quackery or aiming at last to deal it the long-evaded death-blow. As early as 1605 we find good Dr. Guybon riding out to the charge with 'Beware of Pickpockets. Or a Caveat to sick folkes to take heede of unlearned phisitions and unskilfull chyrurgians'; but neither this heavy artillery nor the unbroken fire of subsequent English doctors could daunt the brave hosts of mountebanks who have marched on through the decades, healing the well and making the sick remember their pains. English sovereigns down through Queen Anne continued to exercise the 'Royal Touch'; in 1665 one Valentine Greatrakes successfully laid claim to this same healing power; a certain Dr. John Ward gloriously humbugged King George the Second; somewhat later, Elisha Perkins (1741–1799), of Norwich, Conn., son and father of Yale graduates, enthralled two continents—laity and physicians alike—with his Metallic Tractors. Then, in the early nineteenth century, *floruit* (on pickings estimated at fifteen thousand pounds per annum) suave John St. John Long, of whom Dr. Francis R. Packard says: 'The list of his patients reads like a directory to the fashionable quarter of London.' These are only a few, the more gigantic, vermin from out the dirty swarm. Everywhere and everywhen we meet with exploiters of secret remedies, unfailing panaceas, advanced treatment (*sic*), and all other alleged cures which stand as quackery (in the words of Dr. A. T. Schofield) 'when used by unqualified men, or if they are advertised or puffed unprofessionally, or connected with any fraud or wilful exaggeration.' But it was left for the modern era to furnish that strangest chapter—of an enormous spread of quackery, along with progress in scientific medicine and the growth of education. Berlin, capital city of the world's least hysterical people, reports an increase of 1,600 per cent. in the number of resident quacks since 1874. For England the roll-call is answered by *The British Medical Journal*

* Paper read before the Yale Biological Club, March 23, 1905.

thus: "John Bull, for all his boasted common sense and hatred of humbug, is still more quack-ridden than any member of the human family except his cute Cousin Jonathan." And as for 'cute Cousin Jonathan's' America—Champe S. Andrews, counsel exclusively retained by the Medical Society of the County of New York to expose medical frauds, is authority for the estimate that in New York City alone there are, against six thousand regular practitioners, twenty thousand quacks. In view, therefore, of its ancient origin, persistence and recent spread, it is not enough to account for quackery on the basis of the Irishman's observation that 'there were always fools in this world; in fact, there must have been some lying around, waiting for the world to begin.' . . . Rather is quackery a well-defined phenomenon, grounded on effective causes. Why it should exist at all, how the worst empiric enjoys custom, often from the cultured, and what measures may be aimed against this social evil are questions which invite examination.

At the very bottom lies the insufficiency of orthodox medicine. Not even the long strides of the last century have brought it to the full rank of an exact science. The doctor must stand by, and, only half intelligently, assist *vis mediatrix naturæ;* until quite recently at least, he could in no wise control her, like the chemist and the engineer. Rather has he been somewhat in the position of the philosopher, who must work, more or less, in the mist, and between uncertain boundaries. That explains not only the early rites of the medicine-man, but the whole belief in proffered panaceas. The alchemist sought the *one* agent which should turn all the baser metals into gold; the philosopher still seeks the *one* truth which shall uncover heaven's mysteries. Is it not equally natural that men should lend a credulous ear to every announcer of the much-sought cure-all?

Then, to this prospect of a universal medicine we must add the call of the new—always so strong in unsettled provinces. I mean, that something in a wide-awake community or a growing sphere of knowledge which sees salvation in the novel. We recognize this tendency in the fad-worship of Indian occultists, in the rapid succession of new systems of philosophy, in the passing dominance of scientific theories and in the brief vogue of methods in therapeutics. Out of this same phenomenon grows the ready acceptance of Quack A's 'Absolutely New Method of Treatment. No Drugs. No Knife' or Empiric B's 'Radical Invention. All Diseases banished without Fail.'

Remember, moreover, the omnipresence of disease, its agonies and the common dread of it. With this monster the doctor is asked to triumphantly close, whereas he can only pelt it at a distance. When the suit is lost, it is usually the law, not the lawyer, on which the vials of bitterness are poured; how seldom comes a fatal sickness for whose

sad issue some doctor isn't blamed! Consider what large proportion of quack remedies is for cancer and incurable female complaints: 'The doctors all gave me up,' writes Figment A; 'I know you have tried the physicians in vain,' blares Humbug Z. It is here, upon affections which scientific medicine confesses it can not help, and also upon maladies born of shrewd playing on one's fear of disease, that the empiric waxes fat. Why shouldn't the invalid take heart and believe? Often the loud assurances act as anodyne; occasionally, they even effect a cure. Or, how can the neuropath and the valetudinarian escape the hypnotism of the quack's terrorizing? For the quack wields a deadly weapon in what psychiatrists recognize as 'the power of the unconscious mind over the body.' He forces credence by calculated emphasis and careful insinuation. He works you into a mood where the mind 'autosuggests,' at times the throwing off of a disease, more usually, belief in a cure or the assumption of imaginary sickness. It is, of course, a familiar fact that the typical medical student goes through the whole calendar of diseases. 'Autosuggestion' is the technical word for this mysterious process; it is what the hypnotist employs, but never to stronger purpose than the superior quack.

Given, on the one hand, this set of causes—the limitations of scientific medicine, the pain and dread of disease, and the power of 'autosuggestion,' and, on the other hand, depraved humanity, hard-driven in the struggle for existence, but cunning in the knowledge of men, and you have the essential parts which, with a few minor pieces, make up into the smooth engine of quackery.

Every newspaper and magazine reader knows how well the quack makes capital out of the limitations of scientific medicine. When the regular practitioner is puzzled, he admits, or when the case transcends cure, he gravely shakes his head. The quack now steps in and begins where the other left off. He 'especially solicits obstinate cases'; 'welcomes the doubter and the skeptic.' He realizes the persuasive value of bold assertion and big promises; how the exclamation-point and the period may appeal more strongly than the careful interrogations of the honest physician. He talks much of the 'thousands who testify to its success,' and thus swaggers himself into the confidence of the poor invalid, whom the doctors, in good conscience, must acknowledge beyond their aid. With so many broken-hearted witnesses of the insufficiency of evolved therapeutics, almost any knave can steal a living by brazenly opposing some dominant practise in medicine—as surgery or the use of drugs. These 'methods' nowadays have a pseudo-physiological basis; with a speciousness it is often hard to confute, tracing all disease back to 'inside nerves,' 'sluggish circulation,' and the like, they impress by the sweep of their assertion and their tone

of scientific explanation. It is scant wonder that the pompous logic moves the incurable, whom neither 'knife' nor 'drugs' can save, vapid ladies of fashion, and the smart shallowpate of 'a little learning.'

But the quack does not depend solely on the agony of disease and the inability of scientific medicine completely to cope with it. He swells the total of victims by magnifying minor ailments and imposing imaginary ones. By cooked mortality statistics he frightens the individual into noticing and treating some indisposition, which the family doctor, generally to no effect, laughingly pronounces not worth bothering about; and then, conversely, by the same process of 'autosuggestion,' a few months' trustful application of the vaunted nostrum brings back the patient's assurance and draws his mind from the ailment. Or, the quack will address himself to the social weakling, and by skilful insistence ascribe failure to 'pelvic disease,' 'nerve exhaustion,' '*and all that,*' as Pope says. The poor numskull and the unattractive girl are quick to seize the hope; yes, not deficient endowments, but dissipation or insidious disease has caused their defeat—good Doctor Slyfox, A.B., M.D., member of six medical institutes and nineteen learned societies, will raise them out of the slough. Again, along this same line of 'autosuggestion,' the quack enlarges his levée by invitations to self-diagnosis. With a subtle mastery of rhetoric he sets forth such an array of 'symptoms' that no diligent pupil need feel he is cast into outer darkness. Follow the fraudulent guide—and yesterday you had consumption; to-day varicocele fastens you in its fangs; to-morrow your kidneys will be fatally weak—and so the falsehood runs.

It may be supposed that caution so palpably absurd would rouse more ridicule than credence. But the hypochondriac, the neuropath, the person of weak judgment (ignorance is no indispensable factor) do not reason in such matters. We are almost led to accept as genuine the testimonial in which it is written, 'I had tried *all* the medicines.' With such people, the high-sounding swagger, pretended altruism and adroit description of past achievements drown out the voices of common sense. Even the normal reader can hardly turn to the quack's advertisement day after day, in a non-critical mood, without experiencing at least a passing influence. The fulsome notices of books and plays, in fact, the whole psychology of advertising, rest on this very principle of 'autosuggestion.' So all the quack requires is a hearing. Given a hook-and-line and a pond of fish, he understands baiting too well, not to land a heavy catch.

Of course, there are contributory factors. The quack has other resources. Notable is his use of that universal weakness, the basis of get-rich-quick schemes and the shopper's bargain,—I mean the fascination of getting something for nothing. The doctor will send you a heavy bill on the first of January or July; the quack offers: 'No Pay

till Cured,' 'Send for Sample Bottle. Free.' How the charlatan manages never to lose out would make a realistic novel in itself. Suffice it to indicate his crafty reliance on creating 'the habit'; one bottle with its high content of alcohol will inevitably 'tone you up,' or admixed opiates may be the 'irresistible pain-killer,' to which you will want to turn again. Quacks are among the largest customers of wineries and distilleries. Recent analyses (by the Massachusetts State Board of Inquiry) have developed the possibility that the druggist's show-case may hold more alcohol than the cellar of the saloon opposite, and many a temperance advocate, quite unknowingly, has drawn inspiration for his lecture from that after-dinner glass of nerve tonic or stomach bitters.

With such instruments at his disposal, restrained by no Hippocratian oath or sacred reputation, left free to run riot, by criminally lax laws, deliberately dead-lettered, the *genus* Quack swarms out over the land. Its species are unnumbered, being marked by every device deceitful ingenuity can conceive. Psycho-therapeutics and knowledge of human nature constitute the quack's entire outfit; all he really needs is moral atrophy and the instincts of a cheap drummer. Such is the baleful etiology of medical quackery.

If confirmation of this diagnosis is desired, it may be sought in the recent spread of quackery and its especial vogue in America. Paradoxical as it sounds, the growth of education, while compelling the quack to improve his methods, has greatly extended his field. Formerly, he seldom worked farther than his voice or circular might carry; now, every literate is a potential victim. His wares are displayed in almost every piece of print that strikes your eye; for the publisher and 'the press' he has subsidized and suborned. So-called family magazines (messes of popular fiction and indecent advertisements) are distributed gratis at the instance and backing of the quack, for whom they are so much purchased propaganda. To the same end he sustains the whole modern plethora of magazines and newspapers. Without his lucrative patronage periodicals, representing the real excess of supply over demand, would end their artificial existence, and so, wherever there is a struggling paper, manhood slumbers and the editor accepts the proffered bribe. How else explain the significant truth that the sectarian press ranks among the worst offenders? The 'yellies,' too, depend as much upon the quack as upon scandal; and the most prosperous of them all affords the grossest example. The editorial columns of a certain evening journal will, no doubt, to-night, blare its owner's championship of the people, while almost every page invites the trust-ground toiler to hand up his savings to swindling men specialists and venders of alcoholic cure-alls. In fact, with a few notable exceptions, such as *The Outlook, Life* and *The New York*

Evening Post, the whole press unblushingly sprinkles its columns with the charlatan's cards. Nearly every New York daily on January 24 reported, at lengths inversely proportional to its abetment of quackery, the exposé of Dr. Henry Kane's Radium-Cure swindle; in the January 22 issue of one of the most reputable of them, I find a conspicuous advertisement of this same discomfited wonder-worker. Shameless self-interest never could have played so slavishly into the quack's hands until the growth of education made publishing a fiercely competitive business.

At the same time, not only has the growth of education placed a megaphone to the empiric's lips, but it has sensitized the public to his call. There is a wider interest in hygiene and therapeutics; people think more about their health and more readily take alarm. 'Health journals' enjoy large circulations; too often nothing more than elaborate handbills of the editor's particular book, 'system,' or hygienic contrivance, and, at best, running wild with 'hints to health' and philippics against the doctors, these magazines only succeed in leaving their readers the shuttlecock of every battledore in quackdom. Similarly, the broadcast discussion of medical problems, in response to the interests of an educated public, creates a kind of diathesis to imaginary disease. Then, vaguely bound up, perhaps, in widespread education is the modern stress of life, hysteria, high nervous tension and susceptibility to fads.

As a final (undetached) cause we must recognize the passion for untrammeled personal freedom, so characteristic of latter days, especially in England and America. It is that attitude which one writer savagely describes as 'jealously safeguarding to every citizen the sacred right of going to the devil in his own way.' Fearing to dispense undue privileges and unjust fetters, framers and executors of the law, notably in the United States, have virtually thrown open the delicate art of healing to almost any person too crack-brained or dishonest to earn an honorable living. Not only does quackery thus recruit directly, but wild-cat schools are permitted to dump upon an overcrowded profession graduates sadly lacking in capacity and training. Most of these must end up as charlatans, in much the same way as the manufacturer, shut out from the restricted trade in the genuine article, caters to the public taste with cheap and tinsel imitations; or, at best, such half-baked doctors impair the efficiency of their brotherhood and shake confidence in it. It is not bare accident that America is at once the 'home of quackery' and the 'home of the free.'

These, therefore—growth of education and the modern spirit of liberty—are the specific forces behind the recent spread of quackery; and America stands as arch-victim, just because they have been at their strongest here.

Even from the foregoing generalizations it must appear that quackery is a seated evil, which the community, in self-defense, ought promptly to weed out. Yet the roots, as we have seen, spread out so variously, that past effort has been without effect, and the future will do no better unless exceptional measures are applied. In this case, it seems, diagnosis is easier than treatment, for the social physician is blocked on every side. Surely, the requirements should be everywhere approximately as high as the better states and countries have set, yet every step towards restriction of practise, even to the safety-point, meets with wrangling opposition. The cry of paternalism is raised, and even the disinterested see in such measures only an attempt at extending the alleged 'Medical Trust.'

Quarantine is proper; government exposure of food adulteration is only right; of course, the state should protect its citizens against fraudulent investment schemes, and every enforcement of these safeguards calls out general praise. But it is ruinous paternalism to save the unwary public from unconscious alcoholism, medical extortion and dangerous malpractise!

Of the same caliber, it seems to me, is that other plea against state interference, to the effect that variance from orthodox practise is not enough to brand a method as quackery. It is urged that progress consists in dissidence, and that the traditional school has no right to sit in judgment. 'The prophet is never believed in his own country,' you know. Such argument—and it is very common—sounds too much like the prattle of those 'advanced thinkers' who would do away with the moral code on the ground that all standards are relative and arbitrary. Further, the records fail to show a single instance where scientific medicine has drawn profit from quackery, nor is the modern broad and progressive attitude likely to cheat any honest radical of an adequate hearing.

Just so long, however, as this repugnance for state interference with medical quackery obtains, it is folly to seek help in that quarter. *Existing* postal laws and statutes on fraud are themselves sufficient to blackeye quackery, and their total failure stands as a pathetic proof of the scant likelihood of ending quackery through the toils of the law. Mr. Andrews reports that a wellnigh insuperable obstacle to his vigorous work is the difficulty of obtaining witnesses; persons are rather diffident about exposing frauds of which they have been the stupid victims. Besides, even in clear cases of fraud, it is often impossible to lay hands on the real culprit; or, if caught, after paying his fine or serving his sentence, the quack can start up the old business in another section under another name; the salutary restraints of public opinion play no part with him. After all, what boots it to crush a dozen or even fifty out of the unnumbered swarm? The press will not em-

phasize the prosecutions, and so their effect is lost. Similarly, the postal department could, quite legally, I believe, stamp out the evil alone, if it dared exclude from the mails every periodical containing a single fraudulent quack advertisement; but how prove its case, and where is the administration which could survive the ensuing clatter about 'usurpation of authority' and 'freedom of the press'?

Legislation, therefore, can only be secondary to ventilation and the education of public opinion. But how educate public opinion, when its educator, the press, is itself irretrievably allied with the forces of evil?

First, obviously, such papers as have not prostituted themselves must agitate; they should expose their brothers' shame and the people's consequent losses. Editor Bok's recent appeal (in *The Ladies' Home Journal*) to the women of the land not to let their babies suck in with their milk the alcohol or opium of 'motherhood' nostrums, and to tear down from fence and barn the quack's advertisement, is the kind of measure that counts. Here, too, is a chance for those wealthy yellow journals, forever bruiting their own altruism, to whom a 'scoop' is more necessary than the quack's gold, to expose typical quacks; they make easier handling than the gas and the beef trust, and the attack, no doubt, would yield even richer sensations than the divorce court. Then, public-spirited men of all professions should everywhere organize—as has just been done in Germany—a systematic campaign against quackery. The recent example of an English workingman's society should be followed, and illuminating tracts be circulated by unions and employers. Perhaps the school boards may be free also to level a blow. I know the tendency is to overcram the curriculum, to attempt to arm the child with a petty smatter against every need in life; but if we are going to teach hygiene at all, if the possible consequences of alcohol and tobacco are to be pointed out, why not lay some stress on a curse just as extensive and no less harmful, one which rests on no natural appetite, but on ignorance and absence of forewarning? At any rate, superintendents of board of education free lectures can include in their admirable courses a few talks on quackery by such qualified experts as Champe S. Andrews, Esq.

Against measures of this sort the press hardly dares raise its voice, and effective legislation will soon follow as the expression of the popular will.

Such procedure, it is hoped, may limit the future annals of quackery, and hasten that golden age when even the doctors can almost agree with Mrs. Eddy that there is no such matter as disease.

HOW CANADA IS SOLVING HER TRANSPORTATION PROBLEM.

By LAWRENCE J. BURPEE.
OTTAWA, CANADA.

IN Canada the main lines of transportation run east and west, much more decidedly than they do in the United States. The Dominion is, roughly speaking, a vast parallelogram, three thousand five hundred miles long by perhaps a thousand miles deep. Climatic conditions have in the past confined, and probably will continue to confine, the bulk of the population to the lower or more southerly half of the parallelogram. The problem confronting the people of Canada is, therefore, how best to provide adequate transportation facilities for a population scattered over a relatively narrow belt of country three thousand five hundred miles long. That they have already to a considerable extent solved the problem, the remarkable prosperity of the Dominion at the present time clearly shows; for transportation facilities are an essential of national prosperity in any country, and especially so in one of such formidable distances as Canada.

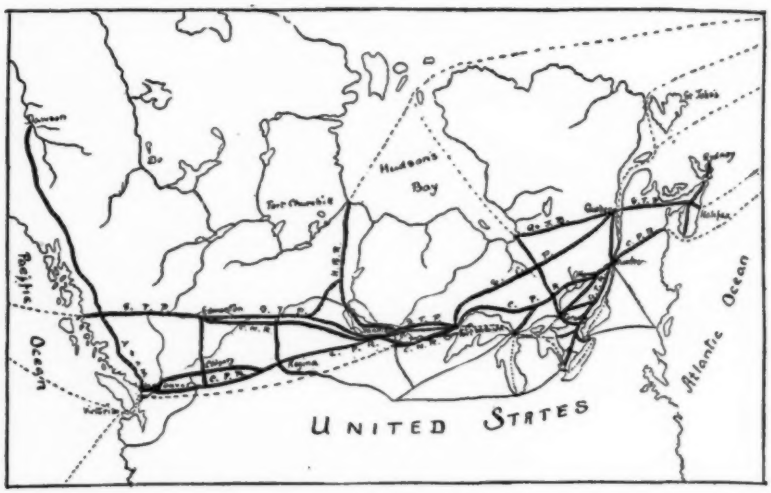
But these facilities must keep pace with the industrial development of the country, and the industrial development of Canada is rapidly outdistancing its means of transport. To bring these two great factors of national prosperity into line, and keep them there, is the question of the hour in Canada, and the statesmen of the country are devoting themselves to its solution with a largeness of view and farsightedness which augurs well for the future of the young Dominion.

A glance at the map will show that in the facilities afforded for transportation, nature has been on the whole very kind to the people of Canada. She has provided, in the first place, an unrivaled system of water transportation extending from the Atlantic to the head of Lake Superior—almost half way across the continent; and, as if this were not enough, an alternative and shorter route is furnished from Lake Huron to the St. Lawrence, *viâ* French River, Lake Nipissing and the Ottawa. West of Lake Superior we find a system of lakes and rivers extending, with inconsiderable breaks, from the head of the Great Lakes to the foothills of the Rockies, to Hudson's Bay and to the mouth of the Mackenzie River on the extreme northern boundary of the Dominion.

While nature placed formidable obstacles in the way of Canada's first transcontinental railroad—the Canadian Pacific—both along the north shore of Lake Superior and in the Kicking Horse Pass through

the Rocky Mountains, she has provided for the country's second transcontinental a route, farther north, remarkable for its exceptionally low gradients, and including the easiest pass to be found in the whole length of the Rockies.

The natural waterways of the Dominion have been developed and improved systematically for many years past, until this great work has come to be regarded as a fixed national policy, which no government, even though it were so inclined, would have the hardihood to abandon. Up to the present time Canada has spent upon her canals over one hundred and seven millions of dollars, and is likely to expend many



TRANSPORTATION LINES OF CANADA.

times that amount in the years to come. The history of Canadian canals goes back even to the French *régime,* when small canals and locks were built to overcome the Lachine and other rapids on the St. Lawrence. These were but canals in miniature—ditches, 6 or 7 feet wide by perhaps 2½ feet deep, designed to meet the needs of the fur traders' canoes. A similar canal was constructed by the Northwest Fur Company, at Sault Ste. Marie, in the eighteenth century—the earliest progenitor of the gigantic twin canals, American and Canadian, of the present day, through which passes annually a much greater tonnage than that of the Suez canal. The 2½-foot Lachine canal of two hundred years ago has grown to a depth of 18 feet on the sill, 45 feet wide and 270 feet long, in each of five locks, the entire length of the canal with the approaches being eight and a half miles.

From the earliest history of the country the east and west trend of transportation has been marked. The first railways of the country were built to connect a handful of small towns, villages and settlements,

strung like beads on a wire along the north shore of Lake Ontario. Gradually the rails were pushed east and west; east to Montreal and the French-Canadian towns on the lower St. Lawrence, and west to the Niagara peninsula and along the north shore of Lake Erie to the international boundary at Detroit. Then, when the scattered colonies of British North America were at last confederated in the Dominion of Canada, the Intercolonial—Canada's national railroad—was built from Halifax, on the Atlantic seaboard, to Levis, opposite the city of Quebec; subsequently being extended to Montreal.

Finally, with a courage and faith in the country's future which the succeeding years have fully justified, the Canadian Pacific railway was built (subsidized with twenty-five million dollars out of the treasury of the young Dominion, and twenty-five million acres of land), and Canada at last had a railway from ocean to ocean, throughout her entire length, making accessible the vast fertile plains of the northwest, with their incalculable agricultural wealth, and providing transportation facilities between eastern Canada and the new province of British Columbia. Up to the present time Canada has expended on her railways in the form of cash subsidies, irrespective of the value of land grants, and irrespective also of the cost of the Intercolonial ($77,000,000, including rolling stock) an aggregate—enormous in view of the comparatively small population of the country—of two hundred and forty million dollars.

When the first Canadian Pacific train crossed the prairies of western Canada, not quite nineteen years ago, that land of promise held only a handful of white settlers. To-day there are six hundred thousand, and new settlers are coming in increasing numbers every year. A few years ago men would have laughed to scorn the idea that western Canada might some day become the granary of the British empire. To-day it is accepted as a self-evident proposition, to be realized within a very few years. In 1904 this western country yielded, in spite of adverse conditions, 60,000,000 bushels of wheat valued at $40,000,000, besides other grains worth another $10,000,000. This year it is estimated that the wheat crop will pass the hundred million mark; and hard-headed business men, not given to idle boasting, confidently predict that within the next quarter of a century western Canada will produce half a billion bushels of wheat annually. The acreage this year under wheat will exceed four millions; but this constitutes but a fraction of the acreage actually available in Manitoba and the territories for profitable wheat raising. With an available acreage estimated at over one hundred millions, and a rapidly increasing population, he would be a bold pessimist who would deny the coming greatness of the Canadian west as a dominant factor in the world's wheat markets. Under such conditions, it is well that the government of

the Dominion rests in the hands of a strong administration, led by a statesman of commanding ability and exceptional breadth of view. Courage and wisdom to build not merely for the present were never more vitally necessary to the well-being of Canada. The government in its transportation policy is showing the same broad faith in the destiny of the country revealed by its predecessors in connection with the building of the Canadian Pacific.

The rapid development of the west, and the increasing difficulty experienced in handling the grain crops of Manitoba and the territories, made it apparent two or three years ago that provision must be made —and made at the earliest possible moment—for additional transportation facilities between eastern and western Canada. The situation was partially relieved by the construction, through the enterprise of a couple of energetic Canadians, of the Canadian Northern Railway, which provides an additional outlet from the western wheat-fields to the head of navigation at Fort William, where connection is made with the steamers running to Owen Sound, Collingwood and other ports on Lake Huron. Even this rapidly growing system has, however, only partially met the situation. The real solution of the problem is being found in the great project for building another transcontinental road across Canada from ocean to ocean.

The Grand Trunk Pacific is the fruit of the brains of two very remarkable men, Sir Wilfrid Laurier and Mr. Charles M. Hays, general manager of the Grand Trunk railway. One saw the project from the point of view of national statesmanship; the other developed it as a practical business proposition. Briefly, the agreement between the Canadian government and the Grand Trunk Pacific is this: The new transcontinental is divided into two sections. The eastern section, from Moncton, New Brunswick, to Winnipeg, *viâ* Quebec, is being built by the government at the public expense, and upon completion will be leased to the Grand Trunk Pacific for fifty years, with the privilege of renewing the lease for a further period of fifty years. The western section, from Winnipeg, *viâ* Edmonton and the Peace River Pass to Port Simpson on the Pacific, is being constructed directly by the Grand Trunk Pacific Railway Company, the Dominion government guaranteeing the bonds of the company to an amount equal to seventy-five per cent. of the cost of construction. When the entire road is completed, from Moncton, N. B., to Port Simpson, it will be operated by the Grand Trunk Pacific from ocean to ocean, and the railway will be supplemented, as in the case of the Canadian Pacific,* by lines of

* It may be noted here that the Canadian Pacific has arranged for the construction of several new vessels for their Atlantic service which are to have a guaranteed speed of twenty knots an hour and are expected to reduce the time from Moville to Rimouski to five days and four hours.

steamers plying from Quebec or Halifax on the Atlantic to Liverpool, and from Port Simpson to Japan, China and perhaps Australia. At Moncton the Grand Trunk Pacific will make connection with the Intercolonial, over which it will have running rights to Halifax and St. John.

No more forcible evidence could be presented of the keen interest now taken by Canada and the Canadian government in the adequate development of the transportation facilities of the country, than the fact that within the last year or two no less than three official commissions have been created to deal with different phases of the same wide subject. These are, the commission on transportation, the board of railway commissioners and the national transcontinental railway commission. The members of each commission are men of the highest standing, chosen because of their special knowledge and experience in regard to transportation.

The first of these commissions is charged with the duty of investigating every branch of the transportation problem in Canada. The commissioners are to study the best available rail and water routes; the improvement of lake, river and ocean ports; the improvement of the St. Lawrence route; the adjustment of freight rates; foreign competition in transportation; and other questions of a like nature. The commissioners have already accumulated a mass of invaluable data, gathered by personal examination, and supplemented by the views of practical railway and shipping men and others connected in one way or another with the transportation interests of the country. When these facts and figures have been digested, the result will be submitted to the government, with recommendations from the commission covering a broad and comprehensive plan of transportation development by rail and water, designed to meet the large needs of a rapidly growing country.

The board of railways commissioners is a permanent department of the federal government, with offices at Ottawa. The commissioners are, however, continually moving about the country, from Cape Breton to Vancouver Island, hearing and adjusting disputes of all kinds—as to freight rates, station accommodation, the distribution of rolling stock, and a host of other questions at issue between municipalities or individuals and the various railway corporations. The board is vested with very large powers, and their decisions have so far been characterized by a spirit of conciliation and common sense, which have commended them to not only the people at large, but also to the special interests affected. The decisions of the board may be overruled by the privy council, but in practise the commissioners have fortunately a free hand, and the results so far have been of immense benefit to the country. Much of the initial success of the board in the settlement of disputes between the people and the railways was due to the wide familiarity with

the questions involved, the shrewd common sense and the recognized impartiality of the first chairman of the board, Hon. A. G. Blair, formerly minister of railways and canals in the Dominion cabinet. Under his control the board was instrumental in settling, by a policy of conciliation and mutual concession, and with reasonable satisfaction to all parties, a multitude of disputes which had been sources of bitterness and irritation in the districts affected. Mr. Blair's resignation, shortly before the last Canadian elections, was felt at the time to be an irreparable loss, as his was by all odds the master mind of the commission. Fortunately the government has secured, in Mr. Justice Killam, of the Supreme Court of Canada, a successor who possesses much of Mr. Blair's shrewdness and tact, as well as the alert mind and legal knowledge of an eminent jurist.

The third of this remarkable triumvirate of transportation commissions is charged with the location and construction of the eastern half of the new Transcontinental railway.

There are to-day in Canada some 170 railways, twenty-five of which are amalgamated in the grand Trunk system and thirty in the Canadian Pacific. The rest, with the exception of the Intercolonial and the Canadian Northern, are comparatively short, local roads. The total railway mileage of the country is now about twenty thousand, of which the Canadian Pacific accounts for nearly one half, and the Grand Trunk, some 3,200 miles. Of the existing roads, the Canadian Northern is growing with the greatest rapidity. It is expected that by the coming autumn the rails will be laid as far as Edmonton—making a second through line from Fort William almost to the foothills of the Rockies. But the men who are behind the Canadian Northern are by no means satisfied with this program. They look forward to a much wider development for their road, and confidently expect to make it the third Canadian transcontinental. At present the main line extends from Fort William to the neighborhood of Battleford. Then in the east the Canadian Northern interests control the Great Northern, from the city of Quebec to Hawkesbury, on the lower Ottawa; and they are now applying to parliament for authority to construct the intervening link between Hawkesbury and Fort William, *viâ* Ottawa and north of the Great Lakes. When this link is completed, and the western end of the railway carried to Edmonton and the Rockies, and thence to the Pacific coast, the Canadian Northern will have a through line from Quebec to the Pacific.

With the completion of the Grank Trunk Pacific, and the Canadian Northern, Canada will have three distinct transcontinental railways, and eventually these will in all probability be increased by one and perhaps two others. One at least of these will run through the

far north, probably as far north of the Grand Trunk Pacific as that is beyond the Canadian Pacific. The continuation of such a road has already been seriously considered in Canada, a group of Canadian, American and English capitalists having projected several years ago what was to be known as the Trans-Canada railway. This line was to run from Chicoutimi on the Saguenay River, or the city of Quebec, in a practically air line through northern Ontario and Quebec, north of Lake Winnipeg, and through the upper parts of the territories of Saskatchewan, Alberta and Athabaska* to the Rockies, and thence to the Pacific. The company had even made some little headway with surveys of the proposed route—which was to include a branch to James Bay, and another from Edmonton to Dawson—and was negotiating with the federal government as to a subsidy, when the floating of the Grank Trunk Pacific project, backed by the powerful Grank Trunk interests, and with the certainty of early construction, knocked the Trans-Canada scheme on the head, for the time being. There is small doubt, however, that this line, or one following the same general route, must eventually be built to meet the needs of the country, as the tide of settlement pushes gradually to the northward.

The importance of the Canadian transcontinental routes is not confined to Canada or Canadian interests. These routes are of course designed primarily to build up the Dominion, and facilitate interprovincial as well as international commerce. Incidentally they become a factor of increasing importance in the opening up of new markets for Canadian products beyond the eastern and western seas. But there is a further and wider field in which they are a feature, the significance of which is seldom recognized. As a link in the chain of transportation between the heart of the British Empire and its outermost boundaries, especially for the carriage of troops and war materials, it would be impossible to overestimate the value of the present and prospective transcontinental lines across Canada.

In eastern Canada, the Canadian Pacific and the Grank Trunk are, and have been for many years past, great rivals. In the west the Canadian Pacific had until lately a monopoly of the traffic, but the advent and rapid development of the Canadian Northern has put quite a new face upon the western situation, and has resulted, for one thing, in a lowering of freight rates from all points in the Canadian wheat belt to Lake Superior ports, which has been of very decided advantage to the farmers of Manitoba and the northwest. One still hears an occasional grumble from the western Canadian farmer on this score, but as a matter of fact freight rates on both the Canadian Pacific and

* Now the Provinces of Alberta and Saskatchewan.

Canadian Northern are now considerably lower than obtain on the Great Northern and Northern Pacific for the same distances.

It seems at first sight rather hard lines that the Canadian Pacific, after fighting alone through the long lean years of western traffic—when the pessimistic prediction that the Canadian Pacific railway would never earn enough to pay for its axle-grease seemed about to be verified—should now, on the threshold of the fat years of western growth and prosperity, be faced with the competition not merely of one, but of two great rivals in the west. As a matter of fact, however, the Canadian Pacific has suffered very little loss of traffic from the competition of the Canadian Northern, and is not likely to suffer eventually from the competition of the Grank Trunk Pacific. Western Canada is growing faster than the railways; the two existing roads in the west have already pretty well all the traffic they can conveniently handle, especially during the harvest, and by the time the Grand Trunk Pacific is completed there will probably be more than enough for all three.

The completion of the Grand Trunk Pacific, and the impetus that will thereby be given to settlement in the northern half of the great Canadian wheat belt, must inevitably lead to a demand for another transcontinental still farther north. It is a curious but indisputable fact that as wheat cultivation is extended north, the limits of the wheat zone are pushed forward,* and the total acreage available for cultivation increases from year to year. There will be ample room for another railway, and perhaps two, north of the route of the Grand Trunk Pacific, and still well within the wheat belt. When grain or other shipments reach Fort William from the west, they have the choice of either a rail or a water route. At present the Canadian Pacific offers the only rail route, but within a few years the Grand Trunk Pacific and the Canadian Northern will both have through lines from Fort William east.

The water routes east of Fort William are practically identical until Lake Huron is reached. There they branch out to a number of Canadian and American lake ports, where connection is made with the Grand Trunk, the eastern lines of the Canadian Pacific, and other roads leading east or south. Another route traverses Lakes Erie and Ontario, *viâ* the Welland and St. Lawrence canals, to Montreal. In time two alternative and shorter water routes will be available from Lake Huron to Montreal; the first, *viâ* the Trent Valley canal, now in course of construction, and on which the government has built an enormous hydraulic lift lock, the only one in America; and the other by way of the Georgian Bay canal. This latter project has been

* It is estimated that the hard wheat belt is receding northward at the rate of fifteen miles every year.

under discussion in Canada for a number of years. It was first proposed to build the canal as a private undertaking, a strong company of Canadian and English capitalists having been formed for the purpose. The company asked the federal government to guarantee their bonds; but after some hesitation it was decided that if the work were to be done it would be preferable to do it at the public expense, and make it part of the great canal system of the country.

Last session the Canadian parliament voted a generous sum to provide for a thorough survey of the whole route, and most of this preliminary work has already been completed. The original project only contemplated an 8 or 10 foot channel; but as the discussion dragged on from year to year, the rapid increase in draft of lake shipping made it apparent that such a canal would be next to useless. The proposed depth was accordingly increased to 12, and then to 15 feet. Finally the projectors came out boldly for a 20-foot ship channel, sufficient to accommodate all lake shipping, and making possible the ambitious dream of shipping men for a route which would enable ocean-going vessels to load their cargoes at Fort William, Duluth or Chicago, and proceed to Liverpool without breaking bulk. The estimated cost of such a channel runs all the way from $75,000,000 to $100,000,000; but it is now realized that no smaller project would meet the needs of the country, and it is understood that the Dominion government intends eventually to build the canal with a 20-foot channel.

One other Canadian water route must inevitably be opened up in the next few years—that is the Hudson's Bay route. Several exploration parties have at different times been sent out from Ottawa by the government to examine into the possibilities and advantages of this route, and especially the period of navigability of Hudson's straits. The reports received have been rather conflicting, and as a matter of fact none of the vessels have remained long enough in and around the straits to finally decide the question. Mr. A. P. Low, on the *Neptune* expedition of 1903–4, went fully into this matter, and although his official report has not yet been made public, it is understood to be very favorable. An examination of the earlier reports, taken in connection with the favorable opinions of such authoritative men as Dr. Robert Bell, director of the Geological Survey, and Mr. A. P. Low, leads one to the opinion that the straits are safely navigable for such a period each year as would be quite sufficient to make the Hudson's Bay route commercially successful.

That the people of Manitoba have every confidence in the vast possibilities of this route is proved by the significant fact that the Manitoba government is now agitating for the extension of the provincial boundaries to the shores of Hudson's Bay, the intention being, when this has been accomplished, to build a railway, out of the pro-

vincial revenues, or with a heavy provincial subsidy, from Winnipeg to Fort Churchill.

When this railway has been completed, and a line of steamers placed upon the route from Fort Churchill to Liverpool, it is not difficult to foresee that within a comparatively short time a very large proportion of the wheat of the Canadian northwest available for export will gravitate toward this route; and it would not even be too much to predict that a considerable portion of wheat from Minnesota and the Dakotas would also find its way to Europe *viâ* Hudson's Bay. A very small difference in cost of transportation is sufficient to swing wheat from one route to another; the difference depending partly upon distances, and partly upon rail or water routes, water transportation being of course cheaper than rail. The following table will show at a glance the advantages of the Hudson's Bay route over existing routes to the Atlantic seaboard, so far as distances are concerned:

Winnipeg viâ Hudson's Bay to Liverpool	3,626 miles.
Winnipeg viâ Montreal to Liverpool	4,228 miles.
Duluth viâ Hudson's Bay to Liverpool	3,728 miles.
Duluth viâ New York to Liverpool	4,201 miles.
St. Paul viâ Hudson's Bay to Liverpool	4,096 miles.
St. Paul viâ New York to Liverpool	4,240 miles.

It will be seen that the advantage in favor of the Hudson's Bay route amounts to 600 miles in the case of Winnipeg, nearly 500 miles in the case of Duluth; and 150 miles in the case of St. Paul. When you add to this the fact that the Hudson's Bay route involves only a comparatively short haul by rail, as compared with the existing routes, it will be seen that the advantage is overwhelmingly in favor of the former.

Reverting to the proposition first laid down—that the main Canadian rail and water routes run east and west, it will be seen that this is substantially correct. The only exceptions of any importance are likely to be more in the nature of subsidiary lines than main arteries of transportation. The proposed line from Winnipeg to Fort Churchill is a case in point; another is the suggested branch from Edmonton north and northwest to Dawson. Probably the most important of all will be a line from Vancouver, the western terminus of the Canadian Pacific, *viâ* Port Simpson, the western terminus of the Grand Trunk Pacific, to Dawson and the Yukon. One other possibility of the future is a railway from the city of Quebec, along the north shore of the St. Lawrence, to the strait of Belle Isle; thence across the strait to Newfoundland, where connection would be made with the existing Newfoundland railway to St. Johns. This would give the shortest possible ocean voyage for Canadian and American passengers to England and Europe, and would be of immense advantage for the transport of the mails and of freight, where time is an important object.

THE ANCESTORS OF THE BIG TREES.

By EDWARD W. BERRY,
PASSAIC, N. J.

THE big trees, or sequoias, have furnished a theme for song and story and have been a Mecca for the tourist for so long a time that any remarks regarding the size or longevity of the far-famed trees of Mariposa and Calaveras would seem trite. Their present isolation —for they are but few in number and do not seem to be holding their own in the struggle with the surrounding vegetation or with the cupidity of civilization—but adds to their majestic grandeur.

To the traveler who journeys to California and for the first time stands in their mighty presence many questions may suggest themselves. How long has it taken these giants of the forest to reach up some four hundred feet above mother earth? Were they created thus? Were they just entering upon a career before the red man's fire or the pale-face's ax checked them, or are they the survivors of a long existing line, struggling to maintain themselves in their last stronghold?

The records of their descent are locked up in the rocks and clays of the world, bits of twigs, cones, and occasionally large pieces of trunks that floated down to the ancient seas and were entombed in the sand and mud, to become preserved as fossils for the edification of later ages. Exploration has unearthed a part of this record. Sequoia remains have been found at almost every locality where Mesozoic fossil plants have been discovered; the cones, especially, because of their hard woody structure, being admirably adapted for preservation. In fact the fossil cones were described away back in the first quarter of the nineteenth century, even before the big trees of California had been described.

So we learn that death has played sad havoc in their noble line. Some have been dead, say, seven million years, with thousands of feet of rock lying vertically over their graves. Fig. 1 gives a diagrammatical summary of sequoia evolution, with the accompanying changes in geological, climatic and floral conditions. The left-hand column shows an ideal geological section, with the ages and periods, and their probable durations expressed roughly in years. In the middle column the procession of changing physical conditions are shown, together with the accompanying changes in climate and flora. The right-hand column is devoted exclusively to events in the genealogy of the sequoia.

The earliest known species is represented by well-defined cones

which have been found in the Upper Jurassic of France. When we say that sequoias flourished in the Upper Jurassic we have a dim idea that they are a pretty old type and that, although compared to the most ancient known rocks the Jurassic rocks are mere infants, still the Jurassic age came to a close several million years ago. But we can form no more of a concept of the duration of several million years than

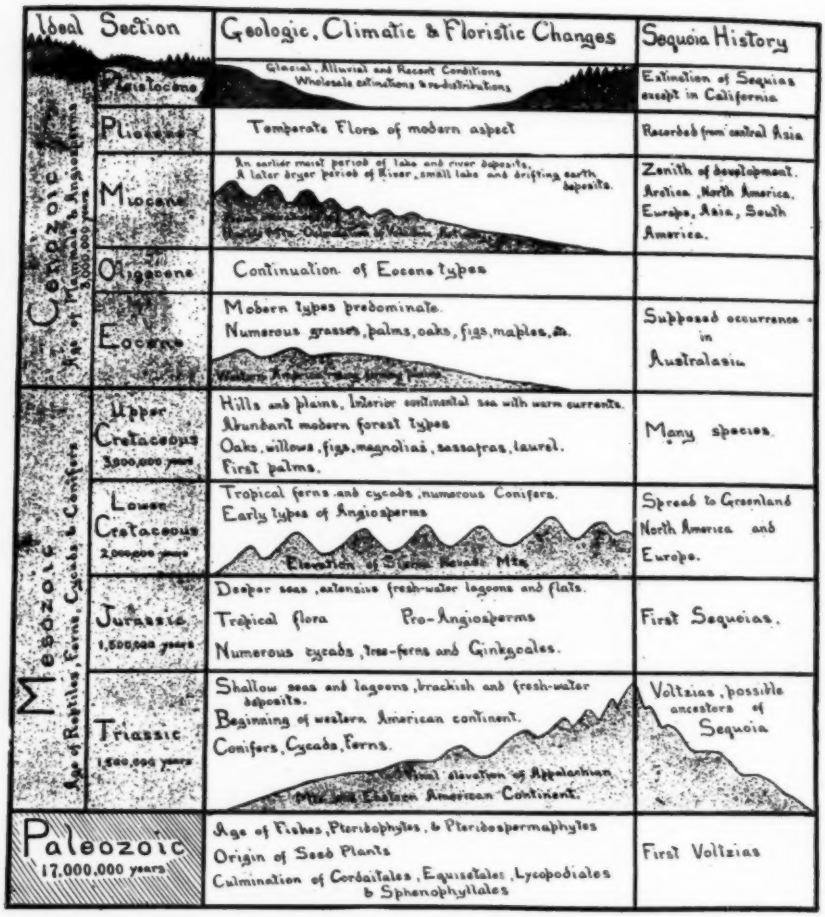


FIG. 1. DIAGRAM SHOWING GEOLOGICAL, CLIMATIC AND FLORISTIC CHANGES IMMEDIATELY PRECEDING AND DURING THE EVOLULION OF THE SEQUOIA.

we do of astronomical distances, and it is only by glancing at the progress of life on the globe during all those years that we can get any sort of an idea of the remoteness of the period.

Fig. 4 is designed to show this progress of life in a general way, in the animal kingdom, which has been chosen rather than the vegetable kingdom because the changes in the former are more striking

and much more apparent to the casual observer. The plants have undergone a like evolution, which has been, however, more of structure than of external appearance. Could imagination transport us to Jurassic times and set us down near the mouth of the Hudson River,

FIG. 2. *Sequoia Reichenbachi*, A WIDESPREAD CRETACEOUS SPECIES, restored from numerous specimens from New Jersey clays.

we should find little that was familiar in either the fauna or the flora. The sediments which now exist as the red sandstones of the Connecticut valley and New Jersey had already been deposited. Volcanic activity

Fig. 3. *Sequoia Langsdorfii*, A WIDESPREAD, CHIEFLY TERTIARY SPECIES.

had been considerable and vast quantities of molten rock had been forced through the crust, forming, among others, the Orange Mountains of New Jersey and the noble line of Palisades along the Hudson.

However, it is quite probable that one would have been as little dis-

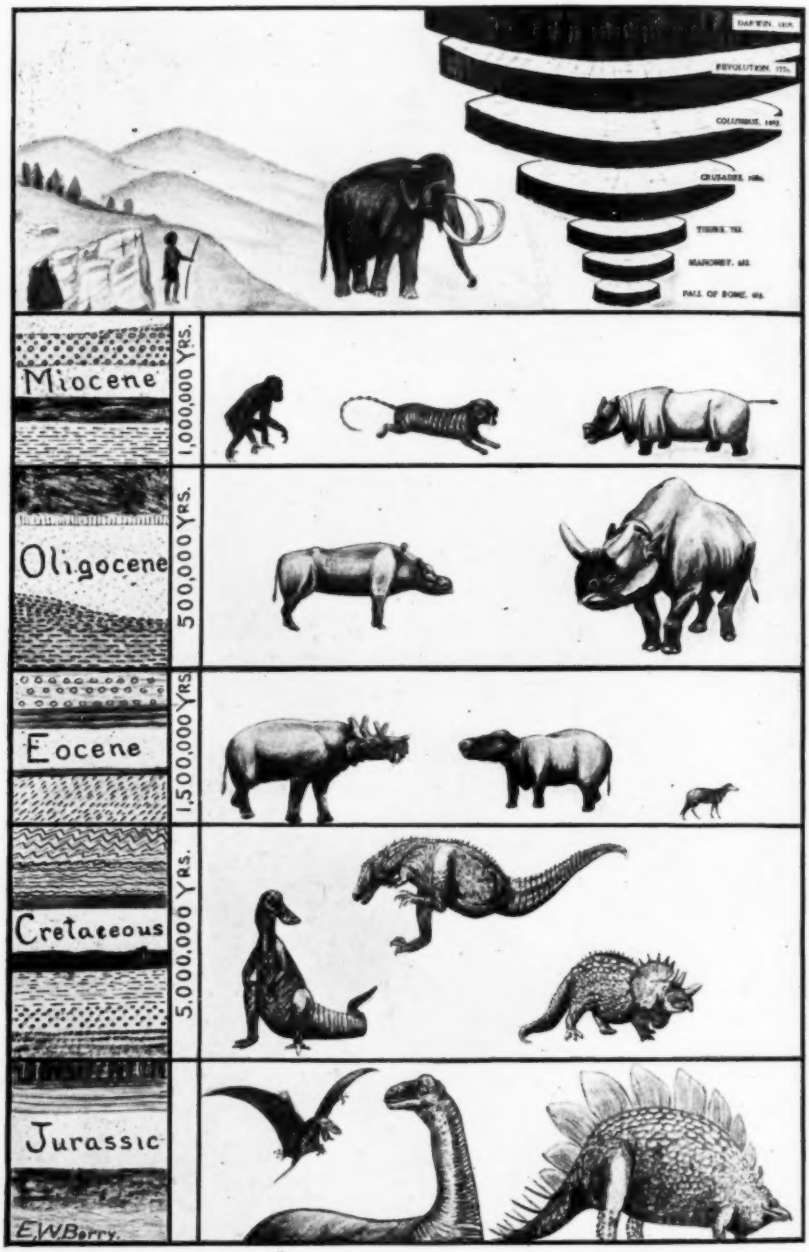


FIG. 4. SECTION SHOWING PROGRESS OF ANIMAL LIFE DURING WHICH SEQUOIAS HAVE FLOURISHED, UPPER SPACE SHOWS COMPARATIVE SECTIONS OF A TRUNK OF THE MODERN TREE.

These restorations which are after Chas. R. Knight's drawings are used with the kind permission of Profesor Henry Fairfield Osborn of the American Museum of Natural History.

turbed by earthquakes eight million years ago as are the inhabitants of New Jersey at the present time by the sinking of their eastern coast. Events moved with inconceivable slowness then as now, though, of course, progress was quickened now and then. Our Jurassic sojourner would find everything strange. In the marshes flourished great ferns with undivided evergreen fronds (Marattiaceæ), and numerous representatives of our modern royal and cinnamon ferns (Osmundaceæ). Close by, ancient tree-ferns (Cyatheaceæ) vied with an amazing variety of forms known as cycads—curious plants of which the commonly cultivated sago palm is a familiar example. In the dryer spots flourished the numerous ancestors of the ginkgo, the maiden-hair tree, that curious relic of bygone days, which has been saved from extinction in modern times by the loving care of the priests about the temples of China and Japan.

The only representatives of those flowering plants which are dominant in the vegetation of the world to-day, the Angiosperms, were the little-known and curious (probably) semi-aquatic plants with netted veined leaves, which have been named pro-angiosperms. Ancient lung-fishes, gar pikes and crocodiles haunt the rivers; out at sea are swarms of sharks and ganoid fishes. Bat-like flying reptiles are the common denizens of the air, the primitive toothed birds with long reptilian tails being in the minority. Sea-inhabiting reptiles of gigantic size, long-necked plesiosaurs and dolphin-like ichthyosaurs, land-inhabiting dinosaurs (the name means terrible lizard), of immense size and bizarre form, are the dominant creatures, while the noble class of mammals with man at their summit is still but a promise and, so far as the fossils indicate, represented by only a few forms of mouse-like size. The continents had not yet assumed their modern dimensions. Such great mountain chains as the Alps, Himalayas and Rockies had not been elevated; and yet the sequoia flourished and its cones were not very different from those found in California at the present time.

The next succeeding geological period, the Cretaceous, continued to be the age of gigantic reptiles, some of which are shown in Fig. 4. The two left-hand monsters figured were between twenty and forty feet long, and were ancient Jerseyites, the spoonbill, a herbivorous, and the leaper, a carnivorous, species. Occasional bones and teeth of these and other related creatures are found in the marl beds that were deposited in the sea off the eastern coast of those days. The Mississippi valley was part of a great gulf that extended northward from the present Gulf of Mexico almost to the Arctic circle, and was a veritable summer sea, peopled with gigantic sea-lizards (mosasaurs), and with a host of other strange forms. Flying reptiles with a spread of fifteen to twenty feet circled overhead.

The vegetation, however, particularly in the Upper Cretaceous, begins to assume a more modern aspect and we find along with the ancient types of ferns (*Cladophlebis, Thyrsopteris*), broad-leaved conifers (*Nageiopsis*), and juniper-like evergreens (*Moriconia*), numerous leaves of oaks, willows, figs, magnolias, sassafras and laurel. The earliest known palms are found at this time. The Cretaceous clays which skirt Raritan Bay in New Jersey abound with these layers of leaves, as do also the Dakota sandstones of the middle west. The magnificent specimen of sequoia with the large cone and the needle-like curved leaves shown in Fig. 2 is from the clays near Cliffwood, N. J., where the twigs are among the most abundant fossils, looking like elegant lithographs against the background of dove-colored clay. This species had cones almost exactly like those of the living Californian tree and the foliage was also very similar. It was a very wide ranging form, and is considered to have been the source (in part at least) of the amber which is so common in the coastal plain Cretaceous at certain points.

Fig. 3 shows a flat-leaved form and attached cone of a species more like the modern redwood, in fact it was probably one of its ancestors, which first appeared during the Cretaceous and which became widely distributed, and continued through the Miocene. During the three to five million years of Cretaceous time the sequoias flourished and became widespread. They saw many changes going on all about them. Beneath their shade new races were springing up; the plants of a modern type which were to replace all others in the struggle for existence had obtained their start; animals gamboled about their trunks or climbed in their branches* that were destined to replace the unintelligent and clumsy reptiles, and by and by to give rise to the horses, dogs and cats of a later day, and finally to produce that animal which was to attain universal distribution, and to be the destructor of countless other species—man.

Remains of sequoias from the lower beds of the Cretaceous have been found in western Europe, in Spitzbergen, in Texas and in the eastern United States. In slightly more recent deposits we find them in Greenland, Canada, in the Black Hills and in Montana. By the middle of the Cretaceous we find over a dozen different species spread over the United States, with still others in Greenland and in central and western Europe. Their remains are often extremely common, whole branches bearing numerous cones, and innumerable twigs, often beautifully preserved, being common fossils. The warm humid climate of the period seems to have been very favorable for their development, and the elevation of the land, by which natural bridges, such as those

* The Cretaceous mammals are all small, about the size of squirrels, and were probably arboreal forest dwellers.

closing Bering Straits and the English Channel, enabled them to spread all over the northern hemisphere and even into the southern, for in the next age, the Eocene, we find their remains in far-off Australia and New Zealand,* while others occur in Alaska, stragglers from the migration into Asia.

The great frozen north of to-day had not yet been hinted at, a warm, if not subtropical, climate prevailed even in the far north, and Greenland was the garden spot that its name implies. On its western coast many plant-beds have been discovered, containing the remains of tree-ferns, cycads, incense cedars, figs, camphor trees, magnolias, eucalypts and other natives of warm climes. This northern region with numerous land connections to lower latitudes was probably the original home of our modern floras and faunas, which spread southward in successive waves of migration. We know that the Mid-Cretaceous witnessed the apparently sudden appearance of a host of new and higher plant types, and the basal Eocene witnessed a like sudden appearance of mammalian types. It is to the frozen north of to-day that we look, hopeful that it will shed light on ancestral forms that flourished there in the far distant past.

With the ushering in of the Eocene period the gigantic reptiles are entirely replaced by higher types; small mammals, some races of which soon attained great size, uncouth beasts long since passed away, besides the remote and generalized ancestors of some of our modern animals. It is in the rocks of this period that we find the dainty little four-toed ancestor of the horse. The Eocene, together with the next period, the Oligocene, represents a couple of million years, during which the sequoias were almost as abundant and widespread as are the pines in our existing flora. In Fig. 4 are shown some of the characteristic animals of these periods, and in Fig. 1 we get some idea of the geological and floral conditions. In the far west this was a time of plains, rivers and lakes, the verdant surroundings of the latter rivaling the Louisiana country of the present day.

Along with the sequoias were many hardwood trees—oaks and maples, hickory and ash; alligators pushed their way through the sedges; the cypress and palmetto grew in Montana, Colorado and Greenland. Stately palms furnished shade for primitive rhinoceroses, tapirs and camels. Monkeys swung from branch to branch and gathered the fruits, where to-day there is nothing but the barren wastes of the alkali 'bad-lands.'

The next period, the Miocene, witnessed the zenith of sequoia development. Contemporaneous with the tapirs, rhinoceroses, horses and

* The identification of these antipodean remains is not entirely beyond question.

saber-toothed tigers, the sequoias are found from Tasmania to Iceland and Spitzbergen, and from Ireland to Japan. Their remains are everywhere—in France, Italy, Greece, Bohemia, Greenland, America—they had even found their way down along the South American coast as far as Chili.

In the Yellowstone region whole forests have been changed to stone by the mineral waters, or buried in the showers of ashes from the active volcanoes in the vicinity. The remains of the trunks are still from six to ten feet in diameter, and the erect butts are often thirty feet or more in height, standing just as they grew, a veritable Aladdin's forest turned to stone. From a microscopic study of the wood we find that these Yellowstone trees are scarcely to be distinguished from the Californian redwood and it seems a reasonable inference that they represent its direct ancestor, particularly as other petrified woods from western Canada are likewise closely related to the redwood. The Miocene, like the Eocene and Oligocene periods, was characterized to a large extent by vast continental fresh-water deposits laid down chiefly by streams, small lakes and drifting sand. To the westward ran a low range of hills, the embryonic Rocky Mountains, where the ancient crystalline strata were slowly pushing their way upward through the overlying Mesozoic and Tertiary rocks. Around the water courses grew swamp maples and alders, gum trees and mulberries; figs still flourished in the latitude of Puget Sound; saber-toothed tigers hunted the hornless rhinoceroses; and the primitive mastodons with four tusks, two in each jaw, vied with the great horned rhinoceroses for possession of the soil.

The volcanic eruptions, which first became a prominent feature during the Cretaceous, culminated during the Miocene, as the immense number of extinct cones in the western half of North America give abundant evidence. The interval between the close of the Miocene and the modern sequoias is imperfectly known. Climates were becoming cooler and the sequoias were on the wane. But few fossils are found and it is presumed that the elevation of mountain ranges, shutting off the vernal breezes, and the consequent alterations in humidity, as well as the vast changes attendant upon the coming of the ice fields of the glacial period, were sufficient to all but extinguish the noble sequoia family.

At about the time the Neanderthal skull housed the brain of a cave dweller who fashioned the paleolithic flints, and who dwelt in the fear of the great hairy mammoth, the cave bear, the hyena and the wooly rhinoceros, or shortly thereafter, the sequoias reached their present habitation in California. Could they but hand down to us the record of history embraced in a generation or two, each lasting between two

and four thousand years, what a tale they might unfold. Tradition has it that Napoleon encouraged his soldiers before the battle of the pyramids with the picturesque phrase 'forty centuries look down upon you,' and yet the span of a single sequoia about equals what to the biblical chronologies of Napoleon seemed the limit of time. Many of the still vigorous and growing trees sprouted about the time that Christ was born at Bethlehem in Judea. Most of those still standing had commenced to grow at least before the fall of Rome. We can count the annual layers in the wood of those which have been cut down, and calculate with considerable accuracy their age and the varying rapidity of their growth. For instance, the huge section on exhibition at the American Museum of Natural History shows that the climate of California was very propitious about the time that Charlemagne was crowned by Pope Leo on Christmas day, A.D. 800, as is evinced by the rapid growth of the tree at that time shown by the comparatively thick layer it added to its girth.

It is not strictly correct to speak of these growth layers as 'annual.' They are primarily the result of the varying rapidity of growth of the cells; thus in trees of temperate climes there is a gradual slowing down of vital activity as the summer advances, followed by a prolonged resting period during the winter, and an accelerated resumption of activity in the spring. These varying functions are recorded in the size and nature of the cells formed. For example, in our oak or chestnut the spring wood consists largely of pitted ducts of large size, which are prominent and in marked contrast with the much smaller celled and more solid additions formed by the slower growth later in the season. In cone-bearing trees like the sequoia the differences are almost entirely of size, the transition being abrupt from the very fine wood-cells formed at the close of the season to the much larger cells of the vigorous vernal growth. In the tropics the varying rapidity of growth is not so marked, although here also there is usually a suspension of vital activity during the hot dry season and a vigorous growth during the humid season. This effectually records the alternation of seasons in the rings of growth. It follows that under certain conditions a tree might add more than one ring in a year, but for our purpose, and generally speaking, it is proper to designate these rings as annual. Year after year the sequoias have been adding layer after layer to their girth in ever widening circles. The thousands of tons of bark shed by each tree during its long career, the tens and hundreds of thousands of tons of sap that have coursed through their venerable trunks, and the innumerable progeny of a single tree in the older, more propitious days—a contemplation of these facts assists us in realizing the true proportions of these forest monarchs. Imagination, however, fails

in an attempt to picture the exquisite beauty of that virgin forest, standing age after age in all its unsullied glory—a veritable forest primeval.

Some of the Californian trees were still in their youth and others were approaching middle age when the various hordes of barbarians overran Europe. They had almost reached their full growth at the time of the Wars of the Roses and the discovery of America. They had reached their present height and girth and ripe old age before modern science had commenced its renaissance; in fact, every avenue of human endeavor—social, religious, industrial and intellectual—has shown its most marvelous progress during the time that it has taken the sequoias to add but a few feet to their already giant frames. In the topmost space of Fig. 4 the growth of an existing sequoia through the centuries is illustrated by an imaginary series of sections of the trunk, drawn to scale, showing the comparative diameter of the trunk at the time when the corresponding notable historical events occurred.

We can but wonder at the persistence of this type practically unchanged, for eon after eon, while all around were dissolution and evolution. Their early contemporaries are almost without exception cut off, and were we to go still further back to the probable ancestors of the sequoias, the Voltzias of the earlier ages, we could carry the genealogy back several million more years, almost to the coal period.

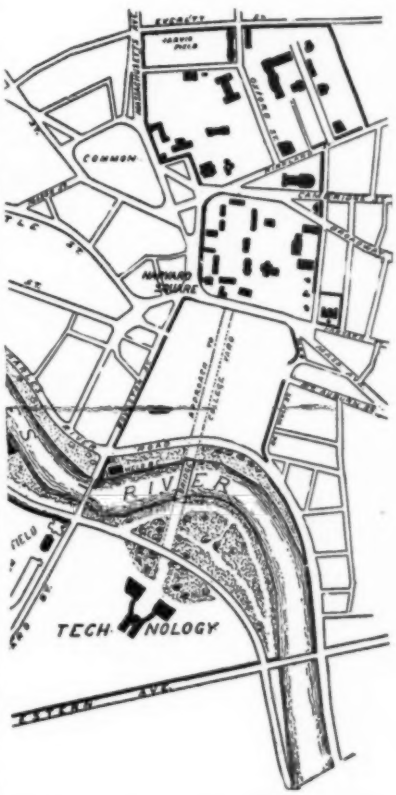
And yet the vicissitudes of time have not succeeded in wholly obliterating these ancient records preserved in the great book of history whose torn pages are the solid rock, and we are able to decipher a line here and a broken chapter there, gradually piecing together the main facts of the story, the reading of which becomes not only a labor of love, but a task of the most absorbing interest.

THE PROGRESS OF SCIENCE.

HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

THE proposed alliance between the Massachusetts Institute of Technology and Harvard University is a matter of more than local interest. Among the questions involved are the relations of technological to liberal and other forms of professional education; the advantages of great size to a university; and the share in the control of educational institutions which should be assumed, respectively, by the trustees, faculty and alumni.

President Eliot has on previous occasions urged the union of the Massachusetts Institute of Technology with Harvard University, but it appears that the present plan was proposed by President Pritchett and the corporation of the institute, led thereto by the large bequest of Gordon McKay to Harvard University for work in applied science. The history of the movement is, in brief, as follows: On May 4, 1904, the corporation of the institute passed a motion requesting its executive committee to ascertain whether any arrangement could be made with Harvard University for a combination of effort in technical education which should substantially preserve the organization of the institute. On September 14, the corporation voted to secure the opinion of the faculty and alumni. On March 24 of the present year, an agreement was presented to the corporation, drawn up by President Henry S. Pritchett and Professor A. Lawrence Lowell, of Harvard University, on behalf of the institute, and by Dr. H. P. Walcott and Mr. Charles Francis Adams, on behalf of the university. This agreement provided for the removal of the institute to the site shown on the accompanying sketch, where it would erect the buildings; the joint work in industrial science would be under the control of an executive committee appointed by the corporation of the institute and containing three members of the Harvard corporation; there would be at the disposal of this committee the income of the funds of the Lawrence Scientific School and three fifths of the income from the McKay



PROPOSED SITE OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND THE APPROACH TO THE BUILDINGS OF HARVARD UNIVERSITY.

bequest; the faculty would consist of the present faculty of the institute and of those professors of the university who now give instruction in industrial science; each of the institutions would retain control of its own funds, and the agreement could be terminated at any time by either party.

This agreement was submitted to the faculty of the institute, which, on May 5, by a vote of fifty-six to seven, adopted a report to the effect that in their opinion it was educationally unsound and prejudicial to the institute's development. The alumni who voted stood 458 in favor of the proposed agreement and 1,351 against it. In spite of this, and the further fact that the faculty of the Lawrence Scientific School was known to be opposed to the agreement, it was adopted by the corporation of the institute on June 9 by a vote of twenty-three to fifteen in a total membership of forty-seven. The agreement must now be submitted to the corporation and overseers of Harvard University, and if adopted by them will be put in force, unless the courts should decide adversely. The present site of the Massachusetts Institute of Technology can not be sold for business purposes without the approval of the courts, and the courts must also decide on the legality of using the income of the McKay bequest in the manner proposed. A committee of the alumni of the institute has been formed to test in the courts the validity of the agreement on behalf of those who have given or bequeathed funds to it.

Various arguments have been urged in favor of the merger and against it. It is said that the same community can not support two schools of applied science, to which it is replied that there is room in New England for two schools of different types, and that the competition would be beneficial rather than injurious. It is said that it is an advantage for a school of technology to be associated with the work of a university in view of the broader culture given to the students, but it is replied that the earnest work of the school of applied science would be weakened by the dilettantism of the college. It is said that economy would result from the merger, but this is denied. It is said that larger gifts would be made to the combined school, but it is replied that the interest of the alumni and other friends of the institute would be alienated.

All these arguments have a certain plausibility. The case in favor of an alliance would certainly be strong if a new school, such as Mr. McKay at one time contemplated, were to be founded. But it is easy to understand the position of the faculty and alumni of the Massachusetts Institute of Technology, the strongest foundation of the kind in the country. They foresee that it would be placed at the mercy of Harvard University, and that the ultimate outcome would be a big school of applied science of Harvard University, rather than a continuation of the individuality and traditions of the Massachusetts Institute of Technology. It certainly appears that when the great majority of the faculty and alumni of the institute are of this opinion, and when the alliance is not wanted by the Lawrence Scientific School, the plan would be inexpedient, and for the corporations of the two institutions to force it would be unwarrantable. Most university professors will concur with the editorial article published in the last number of *The Technology Review*, the concluding sentences of which are "A partnership between Harvard and the institute to which substantially all the parties in interest consented might be practicable; but one like this, which is repugnant to most of those whose good will and enthusiastic efforts are essential, must inevitably result, if attempt is made to force it through, not only in the wrecking of the institute, but also in the controlling of education by

purely business standards. To use the methods of industrial trusts in conducting colleges and universities is to threaten the present efficiency and ultimately the life of all higher education." Thus, for perhaps the first time in the history of our educational system, the autocratic powers of presidents and trustees are directly challenged by the faculty. The outcome will exert a decided influence on the future character and control of our universities.

THE AMERICAN MEDICAL ASSOCIATION.

THE American Medical Association met at Portland, Ore., during the week beginning on July 10, under the presidency of Dr. Lewis S. McMurtry, of Louisville, Ky. There was a registration of 1,714 members, which is more than the average. The scientific sessions were good, and the business transacted was of more than usual importance. It appears that in this case a meeting held during an exposition has proved to be pleasant and successful.

The presidential address reviewed the history of the association which was organized in 1846. For many years it was chiefly a body for the presentation of papers, but it has recently assumed additional functions. Perhaps the most important step was the establishment of a journal some twenty years ago. *The Journal of the American Medical Association* has now become one of the strongest medical publications in the world. The publication expenses last year amounted to not less than $181,000, but in turn the receipts of the association, largely through subscriptions and advertisements for the journal, amounted to $244,709. At the Portland meeting, the association decided to compile a directory of the physicians of the United States, who are said to number about 120,000.

Four years ago the association adopted a plan of organization which appears to be destined to unite the physicians of the country in a powerful body. The county medical societies are made the unit of organization, these are affiliated with the state organizations, which are in turn united in the national association. The legislative body of the national association is a house of delegates to which members are sent from the different states in proportion to the membership in the state societies. This body consists of 150 members, and has proved competent to transact the business of such a society. This form of organization appears to be both more efficient and more democratic than that of the National Educational Association, on which some comments were made here last month. It is, however, significant that both the physicians and the teachers of the country are developing compact organizations which have many of the characteristics of trades unions. They will exert an influence for the material welfare of the members of these professions, and may eventually become strong social and political agencies, which it may be hoped will ordinarily act for the welfare of the whole country.

The American Medical Association applied last year for a charter from congress, but this has not yet been granted. The question will come up again this winter. Here again the American Medical Association appears to be acting more wisely than the National Educational Association, the whole bill being

> Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That [Here follow the names of the incorporators] and their successors, and those who may be associated with them, are hereby made and constituted a body politic and corporate by the name American Medical Association with perpetual succession and power to take, for the purposes of its incorporation, by devise, bequest, grant, gift, purchase, or otherwise, and hold or convey, both real and personal property and transact business anywhere within the United States.
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> Sec. 2. That the object and purpose of such corporation shall be to promote the science and art of medicine and the public health throughout the United States.

DR. WM. J. MAYO, PRESIDENT OF THE AMERICAN MEDICAL ASSOCIATION.

Sec. 3. That such corporation shall have power to make by-laws, rules, and regulations, and choose officers for its government and the attainment of its purposes.

The council on medical education presented an important report. It was stated that the ideal standard to be held up should consist of

a. Preliminary education sufficient to enable the candidate to enter our recognized universities, the passing upon such qualifications by the state authorities

b. A five year medical course, the first year of which should be devoted to physics, chemistry and biology, and such arrangements should be made that this year could be taken either in a school of liberal arts or in the medical school. Of the four years in pure medical work, the first two should be spent in laboratories of anatomy, physiology, pathology, pharmacology, etc., and the last two in close contact with patients in dispensaries and hospitals in the study of medicine, surgery, obstetrics and the specialties.

c. A sixth year as an interne in a hospital or dispensary should then complete the medical course.

The council holds, however, that a four-year approved course with the preparation above mentioned is all that can be expected at present. It believes that a preliminary college education is only desirable for a limited number of men.

The meeting of the association next year will be held at Boston under the presidency of Dr. Wm. J. Mayo, of

Rochester, Minn., who was unanimously elected. Dr. Mayo is one of the leading American surgeons and has the distinction of having declined all calls to large cities and institutions, preferring to remain in the small town where St. Mary's Hospital, of which he is one of the surgeons, was built for his father by the Franciscan sisters.

THE DEPARTMENT OF AGRICULTURE.

IT is much to be regretted that there has been room for criticism of certain officers in the Department of Agriculture. It is also unfortunate that the work of the department may be injured by the lack of perspective and search for sensationalism with which the matter has been treated by the daily press. So far as is known only one officer of the department, and he not a scientific man, has been guilty of acts that warranted dismissal, but which scarcely justify prosecution in the courts. Two other officers of the department—scientific men of standing—have been charged with having connection with commercial concerns while retaining their positions under the government, but in both cases the connection was terminated some time ago. Whether the relation of these officers with the government was used to forward these business enterprises has not yet been made clear. In one case a patent for a discovery was taken out, and the patent given freely to the people of the United States. A company was, however, organized to supply the product. So far as the public knows, the man of science who made the discovery may have acted in an honorable manner. He might have resigned his position, taken out patents and become a millionaire. On the contrary, he gave his patent to the people, and may have taken part in the organization of the company for the public benefit. It appears that at one time he considered resigning from the government service and entering the service of the company, which he certainly had a right to do, but that when he decided to remain in the Department of Agriculture, he gave up his connection with the company. Information has not been made public sufficient for any one to form a judgment as to the conduct of the two men of science referred to. It may have been entirely creditable to them, or it may indicate lack of a nice sense of honor.

An instructor in one of our leading universities made a discovery in the course of a scientific investigation, which he patented and sold for several hundred thousand dollars to a corporation. So far from objecting to this arrangement the trustees gave the scientific man in question leave of absence in order that he might arrange for the sale of his patent in Germany, and shortly afterwards promoted him to a full professorship. If such an instance were now made public in a government department, it would probably be distorted and criticized on all sides, but both the scientific man and the university acted correctly. It is somewhat dangerous for the man of science to keep his eyes on the patent office or to meddle with commercial undertakings, for he may thus be distracted from more important work, but it is still more dangerous to subject the scientific man to orders and discipline from an official superior.

For example, a newspaper as respectable as the N. Y. *Evening Post* seems to regard it as a scandal that a scientific man received payment for an article contributed to a magazine. It would be entirely disastrous to the scientific work done under the government if it were ruled that scientific men could publish only in the government reports. The only reason why these positions are attractive to men of ability is that they have adequate material for scientific work, and that, in addition to the utilitarian work that they do for the government, they are able to contribute to the advancement

of science. The salaries paid to chiefs of divisions are about $3,000 a year, with almost no opportunity for advancement. The government finds it difficult to retain its ablest men of science, they being willing in most cases to accept university appointments. This added to civil service methods, desirable as they are in some regards, is in danger of giving rise to the survival of the unfit in the government service. There is some room for the complaint that men of science in the government service do not do work of as great distinction and originality as should be the case. Presumably this is due to too much supervision and red tape, rather than to too great freedom. The general spirit in the Department of Agriculture is very good, due largely to the wise administration of Secretary Wilson, and it is to be hoped that it may not be injured by an attempt to apply stricter discipline.

SCIENTIFIC ITEMS.

PROFESSOR ALEXANDER MELVILLE BELL, known for his contributions to phonetics, died on August 7, at the age of eighty-six years.

DR. E. RAY LANKESTER, director of the British Museum of Natural History, has been elected president of the British Association for the meeting to be held next year at York.—Dr. William H. Nichols, of New York, gave the presidential address before the Society of Chemical Industry at its general meeting in London on July 10. Dr. Edward Divers, F.R.S., was elected president of the society for the ensuing year.—Dr. Samuel G. Dixon, president of the Academy of Natural Science of Philadelphia, has been appointed commissioner of health for the state of Pennsylvania.—Professor W. W. Mills has been appointed state geologist of Michigan.

A STATUE of Benjamin Franklin is to be erected at Paris at the end of the street that bears his name. Plans have been made for the celebration of the two hundredth anniversary of Franklin's birth, in Boston and New York as well as in Philadelphia.—A tablet was unveiled on July 14, by Signor G. Marconi, on the house in which Sir Humphry Davy once lived at Clifton, Bristol.—The American Medical Association has taken steps for the erection of a suitable memorial to Dr. N. S. Davis, who is regarded as the founder of the association.

THE official party of the British Association, including Professor G. H. Darwin, the president and the other officers, left Southampton by the mail steamer *Saxon* on July 29 for Cape Town, where they arrived on the sixteenth inst. The party included Professor Ernest W. Brown, of Haverford College; Professor Henry S. Carhart, of the University of Michigan; Professor W. M. Davis, of Harvard University, and Professor William B. Scott, of Princeton University.